

Reflections by Meurig Beynon on the IATL "Empirical Modelling evaluation" project ('Constructivist computing ...').

The IATL grant was approved in January 2011, some 8 months before Dr Beynon's retirement in September 2011. The problems we have had in part stem from the fact that we had no idea at the time how this retirement would affect our collaborative research on Empirical Modelling (EM). It seemed plausible for instance that we would be able to achieve more since Beynon would be able to devote his time entirely to EM concerns. We were also hopeful at that time of success in research grant applications - particularly since one of these (for a grant from European Future and Emerging Technologies scheme) was solicited by the Head of R&D at the Center for Futurism in Education at Ben Gurion University in Israel, who was clearly impressed by EM thinking in the educational field.

Our first thought had been that developing the teaching resources to be deployed in the IATL project would be straightforward. We had identified an excellent MSc student (Timothy Monks) with a mathematical background, outstanding computing skills and a strong interest in EM who pursued such development in connection with his dissertation between February and September of 2010. Monks appeared to be committed to the project and discussed his ideas at several meetings with both Russ and Beynon. A major complication was that we became much more familiar over this period with the work that had been done in a closely related area - and using principles in many respects similar to those in EM - under the auspices of the (very successful) GeoGebra open source project. Though Russ's vision was for something quite different from what GeoGebra delivered, it was difficult for Monks to take this on board, and he eventually lost confidence in what perhaps seemed to him to be a failed attempt to emulate the work of the international GeoGebra consortium. In the event - unwilling to submit work that did not meet his own high standards - Monks ended up resitting his dissertation in 2010-11.

This still left us with the possibility of recruiting another student and potentially exploiting the extra time that Beynon would be able to devote to supporting Russ in the IATL project in 2010-11. In practice, this is not how things have worked out. In general terms, Dr Russ's workload has been exceptionally heavy since October 2010, partly because of the critical role he has played in areas such as admissions and schools liaison that have become so topical over this period, partly because he himself is approaching retirement and the department has been keen to ensure that his expertise is shared with younger colleagues who will take over these roles - and partly (somewhat ironically) because he has taken over some of the roles that Beynon formerly played. The end-result has been that Russ has had virtually no time to pursue EM research, Beynon has had to work much more independently on EM research than he had intended, and that Beynon has indeed had to take over some of the research roles that Russ might otherwise have undertaken - such as some writing commissions that Russ was originally expecting to fulfil.

Perhaps more predictably, the profile of EM as a sponsored Computer Science research activity has diminished (even though it still figures prominently on the website as a major component of the Intelligent and Adaptive Systems research group). This has meant that responsibilities that were at one time distributed over a group of enthusiastic EM research students working closely in collaboration with Beynon and Russ have now devolved entirely on to Beynon. One knock-on effect of this is that maintaining tools presents a much greater challenge - a problem confounded by the fact that some legacy software that was relevant to the IATL project could no longer be supported after the shift from the 32 bit to 64 bit Linux operating system last October. We have continued to teach our 40 hour fourth year module CS405, but - for understandable reasons, as EM is not being put forward as part of the REF - there has been no support from the department for maintaining and developing the tools. Though Beynon has been quite successful in

enthusing students about EM via CS405, and has tried to retain a semblance of a research group through voluntarily taking on MSc dissertation and final year project students (8 in total in 2010-11 and 1 MSc-by-research and 4 project students in 2011-12), he is now in a shared office that cannot be used for student supervision. What is most probably Beynon's last doctoral student Nicolas Pope completed last December, and though it has been possible to sponsor Pope to do a limited amount of further casual work on tool development using the money that Beynon earned from teaching CS405 in 2010-11, progress towards goals is at present frustratingly slow.

This account of how the context for our research has evolved over the last two years may help to explain in part why we have not been in a position to spend the IATL grant on evaluation to date. There have nonetheless been some positive spin-offs as a result of our being obliged to keep the challenge of generating suitable materials for evaluation in mind. Russ's original vision was predicated on using our established EDEN interpreter as it was at its peak 3 or 4 years ago when one of its main champions was Antony Harfield completed his PhD. Pope's PhD - developed over the period 2007-11 - was concerned with a rather different concept for supporting EM based on a new interpreter Cadence that was inspired to some degree by what Pope saw as the unavoidable limitations of EDEN. Monks's efforts to use EDEN led him to look critically at both EDEN and Cadence and - in his second effort at an MSc dissertation - to discover a different approach to the implementation of EDEN, based on JavaScript, that can potentially combine the best qualities of EDEN and Cadence. This has led to a new prototype interpreter JS-EDEN that was not only the theme of a fine MSc dissertation submission by Monks, but also generated great enthusiasm from many of the former students who have been involved in the development of EDEN over the last 25 years. It is this prototype that is currently the focus of an open source development project that Beynon is sponsoring in a modest way and that is being led by Pope.

As far as preparing materials for teaching linear algebra is concerned, Beynon has done some work on this theme using the EDEN interpreter, but has not been able to take this to the level that Russ had envisaged because of the limitations it has acquired since Harfield graduated in 2007. Further effort has been put into reimplementing these study materials on the brand new JS-EDEN platform, which has the great advantage of being directly accessible via a modern browser. But, despite its promise, and the potential for eventually going beyond the limitations of EDEN, it will be some time before JS-EDEN approaches the expressive scope of the core EDEN interpreter. Comparisons with systems such as GeoGebra and Scratch point to ways in which to harness the real potential of JS-EDEN through appropriate interfaces, and this is a topical theme in the work of a student who has been studying for an MSc-by-research under Beynon since October 2011, and an MSc dissertation student who will be working alongside her. Another encouraging development that stems from Russ's exploration of potential users of EM in education and his schools liaison work has been strong interest from the Computing at Schools community.

It is unclear whether there is as-of-now a suitable substitute for Russ's original proposal that would satisfy Artur Czumaj's vision for "putting EM to the test". (An alternative proposal that could lead to useful evaluation of EM would involve the producing materials on 'programming for school teachers' that are based on EM principles (using JS-EDEN) that could be trialled at a CaS style teachers day e.g. in three months time).