

JISC Design for Learning Programme

Constructing2Learn Project Completion Report

Project details

Constructing2Learn, <http://dfi.cetis.ac.uk/wiki/index.php/Constructing2Learn>

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Scientific modelling, model construction tools, LAMS, NetLogo, constructionist designs for learning

The goal of the project was to support teachers and students in the building of models in the social and life sciences. We developed a modelling tool called the *BehaviourComposer* that students without prior computer programming experience could use to build, execute, and analyse serious models in their subject of study. We integrated the tool with LAMS 2.0 and built a few LAMS sequences and two activity designs that were used in our evaluation sessions.

Acknowledgements

This work was carried out under the JISC Design for Learning Programme. We are grateful to the following Oxford University academics who advised us and/or used our software and learning designs with their students: Dr Iain Couzin, Dr Edmund Chattoe, Prof Angela McLean, Dr Felix Reed-Tsochas, and Dr Robert Belshaw. The LAMS team in Australia provided frequent and critical support in integrating our software with LAMS version 2.0. Cetis provided us with a wiki-based web site which we used not only for project documents but also the library of micro-behaviours and models used by the students.

Executive Summary

Computer-based modelling is playing an increasingly important role in scientific topics as diverse as ecology, epidemiology, economics, sociology, animal behaviour, and climate. There is a growing awareness that university students in these fields need to learn how models are built and how they work, and yet they do not typically have computer programming skills. We attempted to remedy this by developing a tool that enables students to build models by composing high-level pre-built components, by integrating the tool with a learning activity management system, and by creating and trialling a few computer model construction learning designs.

We developed a modelling tool called the *BehaviourComposer* that students without prior computer programming experience could use to build, execute, and analyse serious models in their subject of study. The novel idea underlying the *BehaviourComposer* is that students can browse, modify, and compose small units of behaviour at a higher-level of interaction than otherwise possible. This made the tool appealing to academics because students can quickly be productive without first mastering the complex technical skill of programming. We integrated the tool with LAMS 2.0 (www.lamsinternational.com) so that learning designs that included use of the *BehaviourComposer* could be authored, executed, and monitored. We built a few LAMS sequences and two detailed activity designs that were used by students on the MBA and MSc Management Research programmes at Oxford's Said Business School and by third year biology students in the Department of Zoology at Oxford University.

We constructed a library of micro-behaviours that support the construction of models of collective animal decision making, a relative agreement model in sociology of how extremism can prevail, models of disease propagation and prevention, a model of an artificial economy, and a predator prey model from ecology. We built and disseminated several sample models using this library.

We first trialled the software and an associated LAMS activity sequence with about 20 Oxford MBA students in April and May 2007. In a single session, using pre-built behaviours and a step-by-step guide, they built an artificial society based upon the book *Growing Artificial Societies* by

Joshua M. Epstein and Robert Axtell (1996). Later, in October 2007 about 30 Oxford Zoology undergraduates used our software and learning designs to build models of how a disease might spread differently depending upon the structure of the social relationships of the population. The scientific modelling and simulation research community has been very receptive to our research, accepting two papers for publication. We also made over thirty presentations to individual researchers, research groups and conferences. The recently started Modelling4All project is building directly upon the work done in the Constructing2Learn project, as are the ReMath and MiGen projects at the London Knowledge Lab.

Project outputs

All of the project outputs are accessible via our website:

<http://dfl.cetis.ac.uk/wiki/index.php/Constructing2Learn>. These include the *BehaviourComposer* software, learning designs, library of micro-behaviours, sample models, reports from testers, lists of presentations and publications, source code, and progress reports. The evaluation report will also be made available on this site during January 2008.

The integration of our *BehaviourComposer* tool with LAMS version 2.0 has been available as a web-based service since it became operational in March 2007. However, the server on which it was running at OUCS was decommissioned soon after the project ended. The source code, screen shots, LAMS activities and a demo are available on the website.

Project outcomes

Constructing2Learn has led directly to the Modelling4All project, which aims to take the work further by building a Web 2.0 version of the software and supporting an on-line community of modellers. See the Sustainability section for more information.

A second key outcome of the Constructing2Learn project is increased interest on the part of our "target" communities. Our academic collaborators at Oxford have expressed strong interest in continuing with the work; we have met with three Oxford zoology students who are interested in doing their third year project with our tools; and an Oxford DPhil student in economics is also exploring the tools as part of his research.

Beyond Oxford, research projects at MIT, Northwestern University, and the Santa Fe Institute have all expressed interest in the Constructing2Learn project and the tools, libraries, and learning designs we developed. We will be giving presentations to these research labs in January 2008.

Project team members

Ken Kahn and Howard Noble are currently participating in the new Modelling4All project, and Liz Masterman is expected to join them in February 2008. Ken Kahn is also participating in the MiGen and ReMath projects at the London Knowledge Lab that are building upon ideas first explored in the Constructing2Learn project. Liz Masterman is currently completing the Phoebe pedagogic planner project and is managing the Thema project in the JISC Learner Experiences of E-learning programme.

Dissemination activity

Project publications include:

1. *Comparing Multi-Agent Models Composed from Micro-Behaviours* by Ken Kahn presented at the Third International Model-to-Model Workshop March 2007 http://dfl.cetis.ac.uk/wiki/uploads/0/0d/M2M_2007_C2L_v4.pdf. This paper has been submitted to the Journal of Artificial Societies and Social Simulation.
2. *Building Computer Models from Small Pieces* by Ken Kahn was presented at the Summer Computer Simulation Conference in July 2007. http://dfl.cetis.ac.uk/wiki/uploads/b/bd/BC_SCSC_San_Diego_v3.pdf

3. <http://www.dlib.org/dlib/january07/01inbrief.html#KAHN> is a short description of the project in the digital library journal, D-Lib Magazine.
4. The ALT-C 2007 Demo entitled *Student creation of serious games and simulations using the BehaviourComposer* was given at the [ALT-C 2007 Conference](#) in September 2007.

Presentations of the project at conferences and meetings of research groups include:

1. 4 July 2006: Ken Kahn presented the project and gave a demo to about 40 people at the LAMS Version 2 workshop hosted at the London Knowledge Lab.
2. 18 July: Ken Kahn presented the project and gave a demo to the Learning Technology Group, OUCS.
3. 29 September: Ken Kahn presented the *BehaviourComposer* software to the workshop on the Pedagogic Issues in Multi-Agent Programming as part of the European Conference on Complex Systems.
4. 12 October: Ken Kahn gave a seminar about the project in the Animal Behaviour Seminar Series at the Department of Zoology at the University of Oxford.
5. 25 October: Ken Kahn gave a talk in the "Digital Projects in Oxford" series at Oxford University Computing Services.
6. 11 November: Ken Kahn described the project and its software briefly as part of his plenary talk at [ISSEP 2006](#)
7. 28 November: Ken Kahn gave a seminar about the project to the [Oxford Complex System Seminar series](#).
8. 16 January 2007: Ken Kahn gave a seminar to the Sociology Department at the University of Surrey. See [Surrey Notes](#). Here are [the slides for the talk](#).
9. 12 February: Ken Kahn gave a seminar about the Constructing2Learn Project to the Centre for Applied Research in Educational Technologies at Cambridge University ([CARET](#)) which was also attended by several people from computer science. John Norman and Patrick Carmichael was particularly interested in our work integrating the BehaviourComposer with LAMS and the learning designs we are developing. We will share our draft designs with them.
10. 2 March: Ken Kahn gave a presentation to OUCS about the project.
11. 7 June: Ken Kahn gave a talk about the Constructing2Learn Project and demonstrated the *BehaviourComposer* at the Swedish Institute of Computer Science.
12. 20 June: Ken Kahn and Howard Noble presented the project and the *BehaviourComposer* to the e-learning MSc students at Oxford University. 45 minutes was set aside for the students to experience the BehaviourComposer by trying the exercises designed for the business school students.
13. 11 July: Ken Kahn gave a talk at Microsoft Research in Redmond Washington about component-based programming for non-experts that included the *BehaviourComposer*. [see a video recording of the talk](#).
14. 17 July: Ken Kahn gave the talk [Building Computer Models from Small Pieces](#) at the Computer Simulation Conference in San Diego California that included a discussion and demo of the *BehaviourComposer* and the C2L Project.
15. 20 July: Ken Kahn gave a [talk about a modelling by non-experts](#) at the Santa Fe Institute in New Mexico about the C2L Project and included a demo of the *BehaviourComposer*. Two researchers there were unable to attend the talk but were given a private demo later that day.
16. 24 August: Ken Kahn gave a [BehaviourComposer workshop](#) at the EuroLogo 2007 conference. About 15 people (a mixture of teachers, graduate students, and researchers) participated in the hands on session that lasted two hours. 7 of the

participants filled out a questionnaire giving us suggestions for improving the software. 2 expressed interest in using it with their students.

17. 5 September: Ken Kahn gave a demo at [ALT-C 2007](#). All seats were taken and several people stood for the presentation. About 30 people total. 2 came up afterwards and said this was just the software they needed. 10 people downloaded the software this week.
18. 20 September: Ken Kahn gave a demo of the *BehaviourComposer* as part of his presentation at [JISC CETIS/Eduserv event](#).
19. 24 September: Ken Kahn gave a demo of the *BehaviourComposer* as part of his presentation to the Learning Technologies Group, OUCS.
20. 5 October: Ken Kahn gave a demo of the *BehaviourComposer* as part of his keynote speech at the WWW/Internet International Conference.
21. 24 October: Liz Masterman gave an overview of the project at the JISC Learning & Teaching Experts' Group meeting.
22. January 2008: Ken Kahn will give seminars at MIT, Northwestern University, and the Santa Fe Institute.

Synergies

The primary synergies have been with i) the Oxford University Modelling4All project funded by the Eduserv Foundation and ii) the London Knowledge Lab and their ReMath and MiGen projects (see next section). Secondary synergies within the Design for Learning programme include the London Pedagogic Planner and Phoebe projects.

Sustainability

As already mentioned, Constructing2Learn has been succeeded by the Modelling4All project (<http://modelling4all.wikidot.com/>) funded by the Eduserv Foundation for two years from August 2007. The design and much of the source code of the *BehaviourComposer* tool, the browsable library of micro-behaviours, and our model construction learning designs form the starting point of this new project, which will take them further into a completely web-based implementation and will also explore Web 2.0 software for supporting an on-line modelling community. Modelling4All will additionally demonstrate the feasibility of running student-constructed models inside a shared virtual space such as *Second Life*.

The London Knowledge Lab has two large-scale ongoing projects that are building upon the ideas explored in the Constructing2Learn project. The ReMath project, funded by the European Framework Programme 6, had a mathematical tool for modelling called MoPiX and has been recently re-implemented to incorporate the ability to use a web browser to find and compose modelling elements. The new 3½-year MiGen project, funded under the ESRC/EPSC TLRP TEL programme, is also building upon ideas developed by Constructing2Learn.

Key messages

The key ideas underlying the Constructing2Learn Project are already informing the projects at the London Knowledge Lab and Oxford University outlined in the previous section. These include the idea of enabling students to build models by using a web browser to find and compose components, a web-based library of behaviours and models, and high-level domain-specific model construction learning designs (some of which are constructed and executed by LAMS version 2).

A key lesson for JISC and further and higher education is that there are opportunities to support pioneering technology-enhanced learning research in various niches of higher education. Computer modelling is important in the physical, life, and social sciences, and HE in those areas can benefit from tools and learning designs that support students in understanding first-hand the process of scientific modelling. There are probably many other niches within FE and HE that could be supported by innovative learning technology, e.g., in music or the arts.

Financial Statement

Note that this is a preliminary budget due to the travel pending in January (agreed previously).

Directly Incurred Staff	TOTAL BUDGET £	Year to 05/06 Actual Expenditure	Year 06/07 Actual Expenditure	Year 07/08 Actual Expenditure	TOTAL EXPENDITURE £
Senior Researcher (70%, 55%, 30% FTE respectively by year)	£ 39,594	£ 6,339	£ 25,906	£ 7,349	£ 39,594
Evaluation Lead (10% FTE)	£ 5,764		£ 4,744	£ 1,020	£ 5,764
Interoperability Specialist (10% FTE)	£ 7,493		£ 6,167	£ 1,326	£ 7,493
Total Directly Incurred Staff (A)	£ 52,851	£ 6,339	£ 36,817	£ 9,695	£ 52,851
Non-Staff					
Consultancy	£ 2,060				
Travel and expenses	£ 2,067	£ 72	£ 375	£ 1,937	£ 2,384
Computer Hardware	£ 250				
Computer Software	£ 250		£ 92		£ 92
Workshops	£ 1,045		£ 317		£ 317
Total Directly Incurred Non- Staff (B)	£ 5,672	£ 72	£ 784	£ 1,937	£ 2,793
Directly Incurred Total (A+B=C) (C)	£ 58,523	£ 6,411	£ 37,601	£ 11,632	£ 55,644
Directly Allocated					
Staff	£ 0	£ 0	£ 0	£ 0	£ 0
Estates	£ 0	£ 0	£ 0	£ 0	£ 0
Other	£ 0	£ 0	£ 0	£ 0	£ 0
Directly Allocated Total (D)	£ 0	£ 0	£ 0	£ 0	£ 0
Indirect Costs (E)	£ 0	£ 0	£ 0	£ 0	£ 0
Total Project Cost (C+D+E)	£ 58,523	£ 6,411	£ 37,601	£ 11,632	£ 55,644
Funds Received from JISC	£ 58,523	£ 10,824	£ 40,177	£ 7,522	£ 58,523
Institutional Contributions	£ 53,189	£ 10,590	£ 36,358	£ 6,241	£ 53,189

Nature of Institutional Contributions

Directly Incurred					
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Final

Staff					
Post, Grade & % FTE	£ 0	£ 0	£ 0	£ 0	£ 0
Directly Incurred Non Staff					
Hardware/Software etc.	£ 0	£ 0	£ 0	£ 0	£ 0
Directly Allocated					
Staff, Estates etc.	£ 0	£ 0	£ 0	£ 0	£ 0
Indirect Costs					
Indirect Costs	£ 53,189	£ 10,590	£ 36,358	£ 6,241	£ 53,189
Total Institutional Contributions	£ 53,189	£ 10,590	£ 36,358	£ 6,241	£ 53,189

** Part of the remaining balance to be used for US travel as agreed.