

## Application Form

The Higher Education Academy's Teaching Development Grant scheme is a competitive process that provides the opportunity to create innovative evidence-informed practice. Funded projects build on pedagogic practice and must have potential to generate impact across a discipline, institution and the sector beyond. In each academic year there are opportunities for individuals, academic departments and collaborative teams within and across subscribing institutions to apply for funds.

In order to encourage innovation more broadly, the call will be open to all the HEA's substantive thematic call areas of Assessment and feedback, Education for sustainable development, Employability, Flexible learning, Internationalisation, Retention and success, Reward and recognition, Students as partners and Online learning.

Where possible, submissions will be acknowledged by return email. The deadline for submission of applications is **midday on Friday 13<sup>th</sup> September 2013**. Please note you will **NOT** receive an automatic acknowledgement of receipt of your application. All applications are acknowledged, but this is done manually so may take a little time. Your patience is appreciated.

When you have completed this application form and gathered the necessary supporting documentation, you should email it to [tdgrants@heacademy.ac.uk](mailto:tdgrants@heacademy.ac.uk). Please do not submit CVs with your application. Selection is based solely on the content of this form.

If you have an enquiry, please email [tdgenquiries@heacademy.ac.uk](mailto:tdgenquiries@heacademy.ac.uk) or contact the Teaching Development Grants team via our switchboard on 01904 717500.

<b>Key contact details</b> (All communication associated with this application will be with the key contact.)	
<b>Name</b>	Mike Joy
<b>Job title</b>	Associate Professor (Reader) in Computer Science
<b>Institution</b>	University of Warwick
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## Project details

### Project title

Online learning of and with digital construals: artefacts that enable new modes of student engagement in computing, computer science education and technology-enhanced learning

### Abstract (max. 100 words)

Provide an abstract that summarises what you plan to do. If you are successful, this information will be displayed on the HEA website to provide background information on your project.

Digital artefacts are central to communication and collaboration in emerging online learning environments. They promote active learning but pose new teaching challenges for assessment and feedback. This project aims to produce online resources for making and evaluating digital *construals*, interactive artefacts with semantic characteristics in common with spreadsheets. Unlike conventional programming, making construals draws directly on students' intuitions about agency and dependency in a domain. Dialogue between teachers and students informed by interaction with construals is a means to develop, refine, articulate and assess understanding. 'Making digital construals' rather than 'writing programs' transforms the learning experiences associated with computing.

### Discipline or subject area

Please identify the discipline area with which your work most closely aligns.

Computer Science /Educational Technology

### Themes

To which of these themes does your project most closely relate?

Assessment and feedback	✓
Education for sustainable development	
Employability	
Flexible learning	✓
Internationalisation	
Retention and success	✓
Reward and recognition	
Students as partners	✓
Online learning	✓

## Key principles

### Key principle: student engagement

In no more than **250 words**, explain how your proposal meets the key principle of student engagement.

Student involvement is central to this project. Students will help to develop tools and exemplars and provide input via interaction histories, commentaries and project reports. Their participation will be essential in evaluating the potential for using the online resources in collaborative development in the spirit of active learning.

- We shall recruit a 3<sup>rd</sup>/4<sup>th</sup> year student to carry out summer vacation work on tool development, documentation and digital construal exemplars. In partnership with a part-time postdoctoral assistant and staff with specialist expertise, they will practise making construals, developing tools, and web programming.
- We shall recruit 2<sup>nd</sup>/3<sup>rd</sup> year students to work as volunteers over the summer vacation, carrying out a pilot exercise in distributed participatory design that will make prototypical use of the online resources being generated in the course of the project. These students will be working from their home locations and liaising with the students and staff engaged in the summer vacation work.
- Students on the *Introduction to Empirical Modelling* (IEM) module in October-December 2014 will also use these resources and contribute to empirical studies of the practice of making construals. Their principal coursework submissions will involve creating and refining exemplars or address aspects of tool development. Selected students will present their coursework at research seminars associated with the project in May 2015.
- Other final year and masters level project students will work on exemplars.

Students will be active members of a network of alumni and researchers with expertise and interest in making construals.

### Key principle: outputs of benefit beyond the host HEI

In no more than **250 words**, explain how your proposal meets the key principle of outputs of benefit beyond the host HEI.

The project contributes to a broader vision of computer science in which making construals complements algorithmic thinking. We hope to influence computer science education both in universities and schools. By providing accessible online resources for making construals, we aim to enable others to replicate the positive experiences we have had of enthusing students about alternative ways of approaching software development. This can enrich the learning experience of students who are at ease with academic computer science as currently taught. It also promises to engage students who find the level of abstraction involved in algorithmic thinking intimidating. Challenging the dominant conception of computing

and its underpinning pedagogy is especially topical at a time when schoolchildren are to be exposed to algorithmic concepts in their earliest lessons in computing. Wider dissemination of our alternative proposal will be essential in determining how to make our prototype principles and tools accessible to learners of different ages, ability and motivation.

We shall also demonstrate the potential of our approach as a way of involving students as partners and implementing new techniques for assessment and feedback. These issues present new challenges to teachers in an emerging culture that promotes active learning in an online environment [1]. Making construals encourages learners and teachers to engage through dialogue that is conducted in parallel with interaction with construals. The significant implications for assessment and feedback will be illustrated with tools and exemplars to be developed in our project. These will involve human judgement supported by automated instrumentation.

**If your proposal does not address these two key principles adequately throughout, your application will not be considered.**

**Project aims and rationale (max. 500 words)**

What are you hoping to achieve? Why is this needed?  
Why should your project be funded?  
What outputs will be produced?

**What we hope to achieve:** We aim to develop the online resources necessary to give wider exposure to principles and tools for making and evaluating *digital construals* (Beynon [2]). These have been developed through partnership between computer science staff and students in the “Empirical Modelling” (EM) project at Warwick University over twenty five years. The project will consolidate a large body of existing resources associated with an annual module (IEM) that introduces EM to Masters level students. It will engage staff from CS through enlisting specialists in automated assessment (Joy [3]), adaptive systems (Cristea [4]) and data mining (Liakata [5]) in tool development, by working in parallel with a Google-sponsored team developing CPD resources for the Computing at School initiative, and by demonstrating the benefits of making construals for teaching mainstream computer science topics.

**Why this is needed:** The standard algorithmic account of computing does not do justice to its contemporary applications. This can alienate computer science students who are enthusiastic about the technology, and prevent them from realizing their full academic potential. Technology-enhanced learning (TEL) environments based on traditional notions of computer programming and use are not sufficiently flexible, and are ill-suited to personal learning and to a constructionist approach. Effective learning applications based on spreadsheet-style principles

exploit the computer in ways that are not well-understood. A better understanding of the roles that computing can play in TEL will transform the learning experience.

**Why our project should be funded:** Many prominent computer scientists recognize the need for a broader conceptual framework for computing, but our approach is unique in that it is based on a practical activity of making construals with a well-established methodological and philosophical foundation. The project is timely, since the principles behind making construals have reached an appropriate level of maturity and the tools prove to be well-matched to emerging web practices and technologies such as HTML 5. The highly successful model of student participation to which the enduring contributions and enthusiasm of EM alumni testify can only be sustained through wider dissemination and adoption.

**The outputs we shall produce:** We shall develop practical resources to introduce the concept of digital construals and support construal comprehension and creation, to include:

- an online interactive web environment in which digital construals can be collaboratively constructed, documented and analysed;
- a suite of video lectures introducing the principles behind making construals
- online exemplars to illustrate applications of digital construals;
- the results of empirical studies of practice, based on data and commentary from both previous and new construal making exercises;
- two publications respectively addressing the implications of our approach for computer science and educational technology targeted at high-profile journals.

In addition to these outputs, we shall establish a web forum that links all the staff and student participants in the project with EM alumni, with a network of interested researchers in computing and education worldwide, and with others whom we hope to recruit via the HEA project itself.

#### **Intended impact (max. 500 words)**

How will your project influence practice and/or policy?  
How will your project improve the student learning experience?

The intended impact of learning to make digital construals has many aspects:

- Ways of creating digital artefacts that are accessible to non-specialists are critically important in contemporary culture. With smart mobile devices, their use in communication is ubiquitous.
- Principles that can be used to critique such artefacts and discriminate between good and bad practice in their construction are essential. This is of central interest in understanding the status of *social construction* in social studies.
- Effective criteria and techniques for assessing the quality of artefacts are likewise vital in education. As the Manifesto for Teaching Online [1] asserts: “text is being toppled as the only mode that matters in academic writing”, with all that this implies for teachers’ strategies for assessment.

Such concerns are equally significant in computing itself. The problematic issue of making and evaluating digital artefacts is clearly related to the challenge of software development – especially where domain learning is involved, and to the status of craft activities such as ICT.

Making digital construals is a possible way forward. It still requires much further exploration, but shows considerable promise. Informal evidence from coursework on the IEM module shows that many students are able to develop construals to capture their evolving personal understanding in an unusually open and flexible manner. The level of engagement is enhanced by the fact that the subject of their construal is freely chosen, and their enjoyment is expressed in – and enhanced by – the interactive way in which they are *enacting* the process of understanding. This encourages them to share their experience of interaction with their construal with each other and with their tutors. On this basis, a dynamic for feedback and assessment quite different from that associated with novice programming is established. The quality of a construal is much more than formal correctness of program code can capture – it is determined by the modeller's degree of familiarity with its potentially meaningful states and the richness of interpretations that can be sustained. In this context, especially where the subject of a student's construal is one of great personal interest, it is not unusual for the roles of the teacher and the learner to be reversed.

To be recognised as an authentic contribution to computer science research and teaching, the culture of making construals is in urgent need of more systematic study and external exposure. In the wise words of an external examiner, commenting on the local flavour of the IEM module: "one does want to ensure that the curriculum of a DEGREE is focussed on ideas that, over time and eventually, gain mainstream and more widespread traction". The work to be carried out in this project lays the foundation for an appropriate response to this concern. If successful, it will enable us to establish an independent short online course on making construals that can be applied in teaching and learning in many disciplines across the higher education sector, including mainstream computer science, and potentially gives non-specialist users an alternative point of entry to well-founded practical computing.

**Methodology (max. 1000 words)**

How will you achieve your aims and objectives?  
What methods and activities will you use?  
What timescales and milestones will you set?  
How will you evaluate the success and impact of your project?

**Context:** Some background information about digital construals is essential for understanding our methodology. The scope of our proposal is broad and ambitious, but builds on exemplars and prototypes already implemented with our desktop tools. The emphasis throughout the project will be on consolidating on work that has demonstrated proof-of-concept, improving documentation, making more accessible interfaces, adapting existing construals for online use, and instrumenting our tools so as to reduce the need for time-consuming manual inspection and analysis in

making and evaluating construals. To this end, we shall distil and refine the best materials from established resources rather than work from scratch. Since 1986, the theme of our proposal – the art and science of digital construals – has been the core subject of Masters level modules, hundreds of projects and refereed publications, twenty postgraduate theses and several international workshops. We have much informal evidence of its potential as a broader vision for computing that is:

- a. applicable in mainstream CS teaching;
- b. topical at the interface between computer science and school computing;
- c. of generic interest where students pursue active learning in online environments.

Refining and collating this evidence is essential in motivating external adopters.

**Team Structure and Personnel:** As team leader, Mike Joy will be responsible for the overall management of the project. The project team will comprise two EM consultants who will co-direct the project in conjunction with an expert in online education (and contributor to [1]) in overall charge of documentation and evaluation, specialist consultants on three key topics in TEL (viz. assessment, adaptivity and data-mining) to advise on tool development, three colleagues engaged in developing a MOOC for schoolteachers, and staff with key roles in schools liaison and IT. Departmental colleagues teaching in areas such as graphics, databases and mathematics will act as project co-supervisors.

Throughout the project, the technical and educational agenda will be addressed with support from a part-time postdoctoral assistant with expertise in JavaScript, test-driven development, GitHub, Chrome and Safari browsers, empirical studies in TEL, techniques for evaluation, questionnaires, data mining, statistical analysis and blogging. In the summer vacation of 2014, a 3<sup>rd</sup>/4<sup>th</sup> year student with EM experience will work alongside the PDA assisted by a further group of 2<sup>nd</sup>/3<sup>rd</sup> year undergraduate student volunteers who will take on the role of users in the distributed participatory design of tools and exemplars. We shall recruit 3<sup>rd</sup> year project students from this pool. We also plan to enlist MSc dissertation and 4<sup>th</sup> year group project students. Appropriate project themes representative of issues a, b and c respectively might be the development of digital construals: to support CS teaching; to be deployed in CPD sessions for teachers, workshops for pupils, or at Open Days; and to monitor group activities in an online/open learning environment.

### **Work plan**

The project will have three phases:

#### **A. Orientation, establishing requirements and development framework**

- Jan-Apr 2014 “Frame tool development requirements”  
“Establish social forum and technical archive”  
Apr-Jun 2014 “Plan quality assessment of construals”  
“Make selection of resources”

*Interim Report to HEA*

#### **B. Development, deployment and evaluation**

- Jun-Oct 2014 “Carry out development”  
Oct-Dec 2014 “Deploy and evaluate”

### **C. Reflection, reviewing, reporting and consolidation**

Dec 2014 - Mar 2015 "Reflection and reporting"

*Completion report to HEA*

Mar 2014 - Jun 2015 "Dissemination and documentation"

*Outputs and resources delivered to HEA*

In phase A, we shall determine what further development and instrumentation of our existing tools is required (a) to make it easier to assess the quality of a construal, and (b) to help learners to make construals. We shall begin by reviewing high quality exemplars from the existing archive, and identifying the criteria by which these have been assessed. Because of the unusual nature of construal development, it will be possible to conduct some data mining analysis retrospectively to identify features of the construction process and the final artefact that contribute to its quality. Workshops with the experts on assessment, adaptivity and data mining will inform strategies for exploiting instrumentation of the tools in relation to objectives (a) and (b). They will also enable us to select which of the existing construals are best suited for further development and documentation as exemplars. These findings will be the content of our interim report in June 2014.

Making construals has two complementary aspects – constructing an interactive artefact, and realizing meaningful ways of interpreting interaction with it. In best practice, the steps of the construction are typically naturally documented in the archive and can be retraced as-if-live. The associated interpretation in the mind of the maker is only made explicit through discussion and informal commentary that is reported or recalled. Makers will be encouraged to submit construals together with blogs to an online technical archive, and to discuss their experience of making construals in the web forum.

Phase B will focus initially on tool development and combine this with deployment of the prototype tools during the summer vacation, when undergraduate students will be participating. Developing the exemplars identified in Phase A will involve the unconventional style of development associated with making construals. So also will much of the tool development. This means that the summer work can be conducted as an exercise in distributed participatory design led by the two assistants at Warwick and a team of undergraduates working remotely. This will generate an exceptionally rich source of empirical data for evaluation that will feed back to inform tool development and lay the foundation for review and analysis during the next phase. It will also provide a platform that will be further tested and evaluated in carrying out and assessing the IEM coursework and student projects in the 2015-16 academic year.

In Phase C, we shall reflect on the project, compiling and analyzing the empirical data and feedback from the technical archive and web forum. Where appropriate, our final report will also draw on questionnaires, interviews with project team members, IEM students and project students, and on their informal and formal presentations and reports.

The project will be steered through monthly meetings of the team leader and co-directors.

## Reference list

In the space provided, and using your preferred bibliographical style, you may insert **up to five** references cited in other substantive sections of this application form.

- [1] The *Manifesto for Teaching Online* at the url: <http://www.swop.education.ed.ac.uk/manifesto.html> (accessed 12/09/2013)
- [2] Meurig Beynon and Hui Zhu, Constructivist Computing - a New Paradigm for Open and Distance Learning?. in Proceedings of the 25th ICDE World Conference, Tianjin, China, 16 -18 October 2013 (to appear). Available online as publication number 124 at the url: [go.warwick.ac.uk/publications/papers/](http://go.warwick.ac.uk/publications/papers/) (accessed 12/09/2013)
- [3] M.S. Joy, N.E. Griffiths and R. Boyatt, The BOSS Online Submission and Assessment System, ACM Journal on Educational Resources in Computing (DOI 10.1145/1163405.1163407) 5(3), pp. 1-28 (2005)
- [4] M Hendrix, A Cristea, W Nejd, Authoring adaptive educational hypermedia on the semantic desktop, International Journal of Learning Technology 3 (3), 230-251
- [5] Maria Liakata, Paul Thompson, Anita de Waard, Raheel Nawaz and Sophia Ananiadou. Comparing three models of scientific discourse annotation for enhanced knowledge extraction, ACL Workshop on Detecting Structure in Scholarly Discourse -DSSD 2012

## Ethical issues (max. 500 words)

Please ensure that you have read BERA's Ethical Guidelines for Educational Research.

What ethical issues will you consider in this project?

How will these issues be reviewed and overcome?

Ethical issues pertinent to this project are *informed consent* and *data collection and storage*.

### Informed consent

The students recruited to work on the project will be notified in advance of the nature of the monitoring and analysis of their electronic interactions with construals, of their contributions to the technical archive, and their communications with the web forum. They will also be advised of the methods and data collection involved and the purposes that it will serve. The performance on the project of a student who participates in summer vacation work, in whatever capacity, will have no bearing on the assessment of their subsequent academic work.

If, during the course of the project, students are due to attend lectures, seminars and tutorials in which activities to be monitored are to be implemented, they will be informed of the nature of the project, the methods and data collection involved and (if appropriate) its intended outcomes linking specifically to their learning. Where there are potential benefits in participating in a study where data is being collected either electronically or manually (e.g. increased engagement and adaptive feedback) these will be shared with students in advance of participation.

Students will be able to make an informed decision about their participation in project-related activities as part of their learning; any students not wishing to have

their interactions or communications monitored will not be excluded from the activities but such data will not be collected and stored by the project team. Students who choose not to engage in this way will not be penalised.

Students who have any concerns about the project will have the opportunity to contact the project team who will answer questions and respond to their concerns.

Formal official consent will be sought through the University's Biomedical and Scientific Research Ethics Committee.

### **Data collection and storage**

Data collected for the purpose of evaluation as part of this project, from electronic interaction histories recorded by the tools or extracted from blogs or the web forum, will be stored anonymously. No personal data will be collected.

Any student researchers who elect to pursue a third year or MSc dissertation project that relates to ethnographic aspects of this research will be made known to other students at the start of this study, together with the nature of the data they are collecting.

Interviews with staff and students will be recorded digitally and these recordings used to create summaries of the discussions. Staff and student participants will be given the opportunity to review the summaries to confirm them as accurate representations of the discussions.

The data will be stored securely on the University's network and made available to the project team for the purpose of evaluating the efficacy of tools for making construals and impact of making construals on teaching and learning within the institution. This data will be stored for ten years following completion of the project to allow for future projects to build on this work and to comply with the University Research Code of Practice.

### **Dissemination (max. 500 words)**

How will you reach your intended audiences?

How will you capture and share the learning that emerges from your project?

How will your dissemination strategy ensure long-term impact and sustainability?

Dissemination will be based on workshop-style events, publication in conferences (to include the HEA conference in July 2014) and journals (to include high-profile international publications on the implications of digital construals for computer science and for learning), webpages and online resources.

Dissemination will feature from the outset of the project, once the core project team is established. By way of orientation in Phase A, the project team will participate in a two-day internal workshop on principles and tools for making construals. This will be based on the existing desktop platform, and associated resources (such as those

developed for a workshop for staff and students in computer science at Burapha University Thailand delivered by the two EM consultants and two EM-alumni doctoral students in May 2013).

After our interim report to the HEA in June 2014 we shall prepare a revised version of our introductory workshop that takes account of the agenda for tool development and our plans for deployment and evaluation. This will be offered to external participants who will be encouraged to subscribe to the web forum and to engage on a voluntary basis during the summer vacation in distributed participatory design activities.

At the end of the project, we shall organize a one day event in which we shall present and discuss our findings with representatives whose interests in digital construals reflect many perspectives. These will include EM-alumni, interested researchers from computer science and other disciplines (e.g. sociology, humanities computing, education) at Warwick and elsewhere, representatives from the HEA community and from schools.

The outcomes of the project will be presented at Warwick in faculty based *Teaching and Learning Showcases*, and more informally as part of the *Window on Teaching* lunchtime sessions.

We shall prepare a presentation for departmental open days, together with an account of making construals that is accessible to schoolteachers with the basic knowledge of computer science and programming similar to that imparted in the Google-sponsored MOOC currently under development in the department.

Throughout the project the team will maintain a project blog which will be regularly updated to report on project development, implementation and evaluation. This blog will invite comment from colleagues across the sector with the aim of informing the project development.

The project will have its own website, with links to the current EM website, but containing carefully selected and curated materials relevant to the theme of digital construals. These will include all publications relating to the project (including 3<sup>rd</sup> year project and dissertation reports).

The tools developed under the auspices of the project will be freely available as open source under the terms currently set out in a GitHub repository. The technical archive of construals will likewise be freely accessible via the project website. Each contribution to the archive will have its own webpage for documentation.

In the longer-term, the project may enable the key ideas behind making digital construals to be sustained through an online course accessible to a wide audience across the HE sector and beyond.

## **Budget**

In this section you should provide a full breakdown of costs, including details of matched funding. You must ensure that your budget represents value for money, and that your proposed work is realistic and achievable for the funding requested. You may request a **maximum of £30,000** from the HEA, and funding may be requested for the following indicative components –

- Release of time from teaching, research or administrative duties;
- Administrative support costs;
- Purchase of training or services;
- Hospitality;
- Travel and subsistence (no international travel);
- Materials (e.g. production of posters and other outputs);
- Impact evaluation;
- Attendance at dissemination events.

The HEA does not fund: normal costs of course delivery, FeC/overheads, contingency funds or international travel. Funded equipment would need to be essential to the running of the project and not routinely available for use. **Your budget should be developed in partnership with your institution's finance or research office(s).**

**Please add rows as required.**

<b>DESCRIPTION</b>		<b>COST (£)</b>
Project Lead: Dr Mike Joy (175 hours @ FA8)	Match	7,714
Project Management: Emma King (175 hours @ FA7)	<b>HEA</b>	<b>5,725</b>
Academic Collaborator: Dr A. Cristea (30 hours @ FA8)	<b>HEA</b>	<b>1,322</b>
Academic Collaborator: Dr M Liakata (30 hours @ FA7)	<b>HEA</b>	<b>1,012</b>
Undergraduate Research Assistant: to be appointed (9 weeks 100% @ FA5)	<b>HEA</b>	<b>6,021</b>
Postgraduate Research Assistant: to be appointed (15 months 25% @ FA6)	<b>HEA</b>	<b>11,400</b>
Administrative Support Costs: Distributed Participatory Design Team	<b>HEA</b>	<b>500</b>
Materials (printing/electronic dissemination material)	<b>HEA</b>	<b>500</b>
Hospitality – two one-day Workshops for 20 people	<b>HEA</b>	<b>1,000</b>
Dissemination Events (UK Conference & HEA Conference)	<b>HEA</b>	<b>2,500</b>
Estate Costs	Match	5,919
Indirect Costs	Match	29,703
<b>TOTAL REQUESTED FROM HEA (maximum £30,000)</b>		<b>29,980</b>
<b>TOTAL INSTITUTIONAL SUPPORT / MATCH FUNDING</b>		<b>43,336</b>
<b>TOTAL COST OF PROJECT</b>		<b>73,316</b>

## Letter of support

You must provide a letter of support, dated and on headed notepaper, from your head of department or a senior representative of your institution. This will guarantee the support of your institution to conduct the project if your application is successful.

## How the HEA will use your details

Your participation in HEA services, including events and any professional recognition awarded to you by the HEA, will be shared on a confidential basis with your organisation. This will enable the HEA and your organisation to work in partnership to champion excellence in learning and teaching and assess the value that its staff, and the organisation as a whole, gains in return for its subscription.

## Declarations

I have reviewed the grant letter that will be issued to all successful applicants and that will be signed by my institution.

I confirm my understanding that successful applicants will automatically be considered for –

- vodcasts to assist in the promotion and dissemination of the TDG scheme;
- presentations at HEA conferences and other events;
- entry into the TDG impact award scheme;
- submission of a narrative to HEA newsletters / e-bulletins in order to facilitate dissemination of the TDG projects.

I confirm that the HEA may use my name and contact details to process this application.

**By submitting this application, I confirm the declarations above and declare that the information provided is true and accurate to the best of my knowledge.**

Signed 	Date 12/9/2013
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Please email your application form,  
along with all necessary supporting documentation,  
to [tdgrants@heacademy.ac.uk](mailto:tdgrants@heacademy.ac.uk)