Orchestrating new forms of learning using technology

STELLARNET Briefing #4
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Orchestrating learning is one of STELLAR's Grand Challenges for TEL. Two case studies illustrate how technology both enhances and challenges teachers' traditional classroom roles.

Orchestrating learning

Orchestrating learning involves co-ordinating episodes of learning, providing continuity throughout a range of activities and establishing appropriate links between different people and resources (Crook et al., 2010).

Challenges for teachers in TEL

In TEL, teachers have a crucial role in balancing greater freedom for students against providing a productive structure for activity, and in managing the flow of control between students, technology and themselves

Examples of orchestrating learning

This STELLAR Briefing describes two projects from the TLRP-TEL Teaching and Learning Research Programme in the UK that illustrate ways in which technology is used to orchestrate novel ways of learning: constructionist learning in mathematics and inquiry learning in science. These approaches could be applied in other subject areas.

Key challenges for teachers in orchestrating TEL:

- managing the integration of new technology with classroom activity structures;
- using TEL tools as an interface to provide guidance for students;
- balancing planned activites against a need to be flexible;
- remaining pro-active and in control of the classroom while being responsive to learners' needs.

STELLAR's Grand Challenge Framework for Technology Enhanced Learning research identifies three priority areas for future investigation: (1) Connecting learners; (2) Orchestrating learning; and (3) Contextualising virtual learning environments and instrumentalising learning contexts. Briefing #1 provided an overview of the Connecting learners theme. This briefing focuses on Orchestrating learning using practical examples taken from the TLRP-TEL Teaching and Learning Research Programme.

Facilitating constructionist learning tasks

The MiGen project developed tools that support teachers' orchestration of classes engaged in self-paced and open-ended constructionist tasks. The tools provide an interface to a complex and potentially confusing activity system by providing an overview of which students are in difficulty, and whether certain trends and misconceptions are common.

In mathematics, generalisation, or seeing a pattern through integrating particular cases, is important in developing early algebra. With this in mind, the MiGen project (Noss et al, 2009) has designed tools that allow students to create and manipulate visual patterns and algebraic expressions and to explore the relationships between them. MiGen is based on a constructionist model of education where students build and share their own knowledge structures. The exploratory nature of this learning means that it is helpful for teachers to be assisted in providing suitable guidance for students. MiGen's Teacher Assistance Tools are used in classrooms alongside student software, allowing teachers to detect which learners are experiencing difficulties, demonstrating misconceptions, or finding the work too easy.

The MiGen system

The MiGen system is a set of interlinked classroom tools. The student software eXpresser (Figure 1) is a mathematical microworld in which students construct 'generalised patterns' and derive the expressions (rules) which underpin them. Students may find different but equivalent solutions since the tasks are open-ended and intended to provide opportunities to develop complex cognitive skills. As students interact with eXpresser, their progress is logged in the background as landmarks. Some landmarks are task-independent, such as when a student makes a building block, while others are task-dependent, such as when a student constructs a block which is appropriate for the current task.

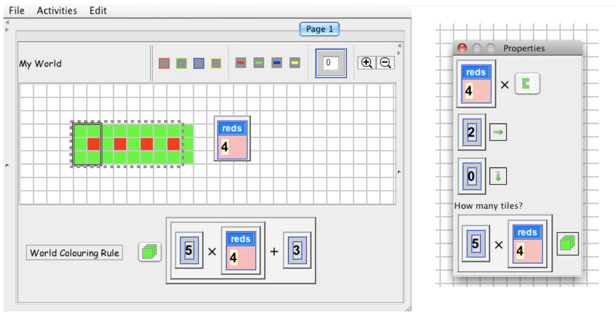

Fig. 1. Students construct a pattern in eXpresser (left) and describe it with a rule (right).

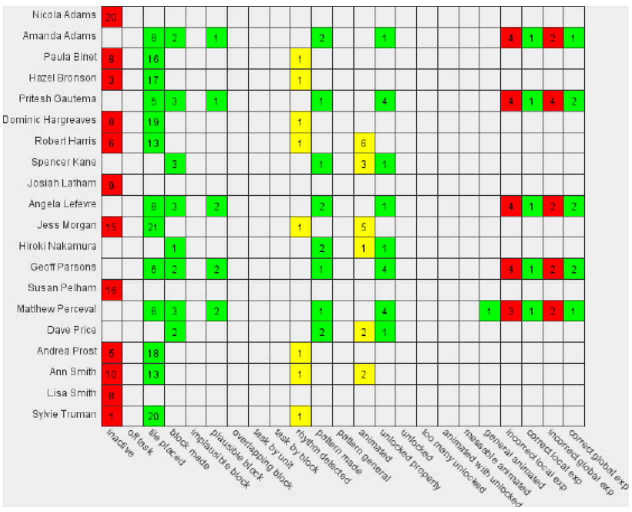

Fig. 2. The Student Tracking Tool showing an overview of the number of times each landmark has occurred for each student during the current task. Positive landmarks are green, negative landmarks are red and neutral landmarks are yellow.

The suite of Teacher Assistance Tools provides overviews of appropriate information for the teacher, compiled from a variety of sources including: log data of students' activities and constructions, individual models of learners (which are constantly updated), task descriptions and possible solutions and the landmarks detected. One tool, the Student Tracking Tool (Figure 2), provides an overview of landmarks for each student so that teachers can follow their progress on each task and use this information to plan appropriate interventions to provide guidance and set new goals. For example, a teacher might be able to see that one student is not active, that another appears to misunderstand the eXpresser tool or the task (or both), and that yet another is progressing well but has not yet animated her construction to test it more generally. Another tool provides a view which represents the same data as a timeline of landmarks for each student. Using the timeline, a teacher can trace progress through a task and monitor students' actions after providing advice. Other tools exist within the MiGen suite to provide direct feedback to students about their work.

For more information see http://www.migen.org/ or contact Richard Noss [r.noss@ioe.ac.uk]

Orchestrating inquiry learning within and beyond the classroom

The Personal Inquiry project aimed to provide a continuous learning experience across contexts in order to support students carrying out autonomous inquiry learning activities. The nQuire toolkit expands the teacher's sphere of orchestration beyond the classroom but the project found that the model of learning and the use of new technologies presented significant challenges to traditional techniques for classroom management.

Inquiry learning calls upon students to plan, carry out and interpret investigations, focusing on students developing experimental and analytical skills rather than knowledge recall. Student projects may involve working within the classroom, participating in supervised out-of-class activities such as field trips and carrying out unsupervised work, possibly at home. The nQuire toolkit was developed to support a seamless transition from the classroom to other contexts (Anastopoulou et al., 2010; Sharples & Anastopoulou, in press). Initially, students use nQuire in the classroom under the guidance of the teacher to preview the inquiry process, propose and discuss their inquiry questions, and plan their investigation. Outside the classroom, the software orchestrates the activity by structuring the inquiry process and guiding and verifying the collection and analysis of data. When students return to the classroom, the teacher can re-establish their supporting role by viewing the results of each student's investigation and employing tools to view and present individual and group results to support wider discussion.

nQuire

The nQuire toolkit (Figure 3) supports students through a sequence of activities including planning inquiries, collecting and analysing data, drawing conclusions and communicating results. The software, a modified content management system, is accessed by students using a web browser on portable netbook computers.

Within the classroom, students browse to a server on the local network and can conduct activities collaboratively. In the field, where often no internet connection is available, students connect to a copy of the software installed on the netbook and may work in groups on a single machine. They use the nQuire toolkit in conjunction with other equipment such as data loggers with sound level sensors, GPS receivers and digital cameras.

nQuire supports a cycle of inquiry (consisting of phases, tools and activities) and manages the relationship between this cycle and time-bounded events such as lessons. The navigation interface is a dynamic ToDo list which can be elaborated, annotated, re-ordered and marked as completed by students. List items can be linked to computer-based activities. The home screen shows a visual representation of the overall inquiry and emphasises the iterative and recursive nature of the process. This representation can be tailored to specific projects.

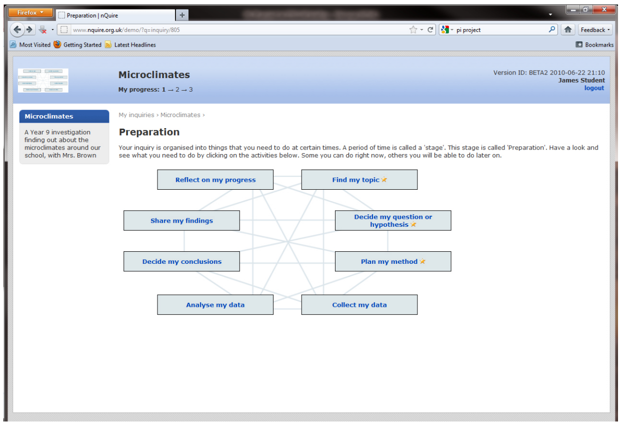

Fig. 3. The nQuire toolkit showing a text entry page

The inquiries supported within the project, on topics such as Healthy Eating and the Effect of Noise Pollution on Birds, enabled students to become individually involved in processes of inquiry and supported their understanding of the scientific method.

Fig. 4. Students working on inquiries in the classroom and on field trips.

Challenges for teachers

The Personal Inquiry project found that the role of the teacher was central for successful orchestration, but that the teacher required different skills from those of conducting a normal lesson. The teacher needed to support students in managing their own projects across contexts, play a role in integrating work conducted externally back into the classroom and manage the disruption of introducing new technology.

For more information see http://www.pi-project.ac.uk/ and http://www.nquire.org.uk/ or contact Mike Sharples [mike.sharples@open.ac.uk]

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The open network of excellence in technology enhanced learning

A variety of questions about orchestration arise out of the examples presented here, for example:

- What new strategies for orchestration should teachers develop when more information about students' progress and problems is available through TEL tools?
- How do constructionist and inquiry-based learning, which allow students greater freedom for exploration and self-guidance, challenge teachers to orchestrate classrooms differently?
- How can teachers use TEL tools to expand their sphere of orchestration beyond face-to-face, classroom interactions — for example, across the web or when students are learning using mobile devices?
- In what ways does introducing digital technology render the activity of orchestration more complex?
- Which elements of orchestration are strongly dependent on institutional setting (e.g. education vs. workplace learning)?
- What is the role of physical space as a setting for learning (such as classrooms or outdoor spaces) and how can this be harnessed to support successful orchestration?

Please share your views at www.teleurope.eu

Key references for this briefing

Stellar Deliverables are available at http://bit.ly/aukWxX

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Sharples, M. & Anastopoulou, S. (in press) Designing Orchestration for Inquiry Learning. In: K. Littleton, E. Scanlon & M. Sharples (Eds.) Orchestrating Inquiry Learning. New York, NY: Routledge.

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STELLAR**NET** unites the disjoint scientific communities with a virtual and distributed centre of excellence that expands the capacity of each research unit and that fits the challenges for the future of TEL.

STELLAR**NET** connects with policy-makers to provide a strategic direction for the integration of TEL excellence to 2012 using a framework that explicitly relates to improving learning and educational systems.

STELLAR**NET** reduces discipline fragmentation by promoting the integration of key European research teams through collaborative projects, research exchanges, sharing of tools, models, concepts, methods and agendas.

STELLAR**NET** reduces community fragmentation by bringing together the key stakeholders in European TEL and stimulate ongoing knowledge exchange between them.

STELLAR**NET** looks beyond the Network partnership and actively solicits the exchange of views, knowledge, feedback and visions of key stakeholders in TEL: researchers, developers, end-users both in education and in industry.

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