Data-logging in the science classroom: approaches to innovation.

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Abstract. Data-logging is now an established but under-used feature of UK science education. It offers a contemporary approach to practical work and the potential achievement of benefits identified by research into its use. This paper describes interview data with science teachers experienced in using data-logging methods. Drawing on a framework from literature on the management of educational innovation, approaches are identified which may lead to wider use of data-logging technology in secondary school science.

Issue. In the UK, information from inspection of schools (OFSTED 1998) indicates that the application of information and communications technology (ICT) to teaching is patchy despite being a requirement of the National Curriculum. The UK government has a programme of investment in ICT resources and skills training for teachers in order to capitalise on the perceived benefits of applying ICT to teaching in general. However, it is in the classroom that data-logging methods will be implemented. What can be learned from teachers successfully integrating data-logging in their science teaching?

Background literature. Research in the UK and the USA has explored the impact of data-logging methods on pupils’ experimental activity. Potentially useful attributes of data-logging technology in classroom use have been identified (Rogers & Wild 1994, 1996) and the development of software tools has provided new opportunities to explore experimental data (Rogers 1997). Research into the impact of data-logging on pupils’ learning in science has indicated the contribution computer-generated graphs can make to pupil’s appreciation of the meaning in the data, and of the advantages of computer-drawn graphs over manual methods (Barton 1997). Research has also identified the potential of computers to contribute to social classroom interactions. In North America, the Technology-Enhanced Secondary Science Instruction (TESSI) project has recently reported findings that, pupils work more independently and value the social dimension of IT-rich settings (Pedretti et al., 1998). The computer as a focus for pupils’ talk has also been the subject of research. Techniques of discourse analysis have been applied to MBL work in 12th grade physics classes to better understand the role of the computer in group contexts and how the context is shaped by the computer. Study of interaction patterns between pupils and computer indicates that pupils draw on the computer representations for support in their developing thinking in experimental work (Kelly and Crawford 1996). The value of teacher interventions remains high in IT-based lessons. Teacher interventions can prompt pupils’ interpretations of computer presented graphical data. Skilful questioning of the pupils by the teacher can assist...
the pupils in their interpretations of data (Barton 1997). However, even without the direct influence of the teacher, there appear to be benefits in pupils attending to emerging graphs in real time data-logging (Newton, 1997).

Harnessing the benefits of data-logging methods for pupils requires the successful implementation of an innovative teaching tool. Research has identified some of the interacting factors which need to be addressed to manage the successful implementation of educational innovation (Fullan 1991; 1992). These factors include characteristics of the innovation itself, namely: needs identification; goal clarity; complexity; and the practicality of the innovation. Other features including teacher roles and external factors are also influential in successful innovation. The purpose of the study was to identify approaches to successful implementation of data-logging in the classroom, by drawing on the experience of science teachers skilled in its use.

**Design.** As part of an observational study of the use of data-logging, a series of semi-structured interviews was carried out with five science teachers working in four different UK secondary schools. Each teacher had volunteered to be involved in the wider research study and had been invited to do so because of their interest in and experience of using data-logging methods in the teaching laboratory. By working with teachers who were familiar with ICT, it was hoped that the problems faced by novices in learning to use data-logging equipment would be reduced, thus allowing the focus to be the application of the technique in the laboratory.

**Procedure and data analysis.** Following a series of lesson observations involving data-logging, the teachers were interviewed to explore their thoughts about and general experience of using the data-logging approach. Each semi-structured interview was conducted by negotiation, in the teacher’s school and tape recorded with their permission. The interviews were then transcribed and the interviewees invited to review the transcript and to correct or amend it. No substantive amendments were requested to the transcripts by the interviewees. The interview data was then imported into software for coding and analysis.

**Findings.** The characteristics of change described by (Fullan 1991) provide a framework for discussing the interview data

1. Needs identification - the need to incorporate data-logging is driven by the demands of the National Curriculum requirement to use ICT to support teaching. However, this need is stated generally in the science Order. The interviewees expressed the perceived need to use data-logging in terms of the attributes of the technology and the benefits it can bring to their science teaching. The benefits included affective domain factors relating to pupils' personal response to the use of ICT.

2. Goal Clarity - the drive to use data-logging needs to be given clarity to help to identify what could be done differently by science teachers employing the technique. Clarity can be improved by planning opportunities within work schemes to use the technique. Full exploitation of data-logging requires developing goals to extend its use beyond data collection to data interpretation. Achieving this shift will require identification of further opportunities to exploit aspects of data-logging software for developing higher order interpretative skills in experimental science. Increasing familiarity with software may itself facilitate identification of further needs which are well served by the technology and consequently lead to development of new goals.
3. Complexity - this refers to the difficulty and extent of change required by individuals new to using data-logging. These changes include the acquisition of skills in operating new technology, but in addition, understanding is required of the new opportunities which data-logging offers. The ways in which this differs from traditional practical science, also need to be understood; as do the perceived threats of new technology to novice users in relation to classroom organisation and management.

4. Practicality - in order to integrate data-logging into science teaching, adequate resources need to be available. Although self-evident, the acquisition of suitable equipment has an impact on the quality of the innovation. Other resources are also required however; for data-logging this can include the availability of time to develop curriculum materials and for in-service training. The need to have a planned and staged programme of development is required, so that change can be developed over time.

References.