# A theory-informed framework for designing software to support reasoning about causation in history

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Paper presentation for CAL 2001

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Key topics:

Continuity and progression
Future learning environments

Other submitted papers:
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J. Meek and M. Sharples "A lifecycle approach to the evaluation of learning technology"

M. Sharples, D. Corlett, O. Westmancott "A Systems Architecture for Handheld Learning Resources**"**

G.N. Vavoula and M. Sharples "A phenomenological study of lifelong learning: implications for the design of a personal, lifelong learning resource"

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We describe the construction of a framework for designing a software tool to support reasoning about the causes of historical events by pupils aged 11-14. Our example demonstrates the principle that applying relevant theories of teaching and learning can bring order to data collected from the field, and thereby provide a cohesive framework for detailed program design.

The raw material for our design took the form of notes and artefacts collected from 46 non-computer based history lessons observed in four schools, two computer-based sessions with small groups and interviews with seven teachers. These were supplemented by surveys of formal research studies into learners' historical reasoning, practical guides to teaching history and informal published accounts of classroom practice by individual teachers.

A comprehensive, atheoretical analysis of this material enabled us to identify many common elements in the methods history teachers use to introduce causation and related concepts, and in pupils' capabilities and limitations when reasoning spontaneously with these concepts. However, determining the optimal ways in which the computer might foster pupils' causal reasoning required a theory-informed understanding of the pedagogical process at three levels. These levels are: (a) the setting - physical and conceptual - in which teaching and learning take place, (b) the activities taking place within that space, and (c) the verbal and non-verbal exchanges between teacher and pupils which form the essence of these activities.

The analysis also yielded a primarily socio-cognitive perspective on teaching and learning in the history classroom: that is, pupils' knowledge of historical content and their understanding of higher-order concepts are constructed initially through collaborative activities guided by the teacher. Therefore at each level of the design framework we selected pedagogical theories that reflect this general perspective.

The top level of our framework - the "hawk's eye view" - is characterised by Vygotsky's concept of the Zone of Proximal Development (ZPD) (Vygotsky, 1978), and includes the teacher, pupils and the artefacts that support them. Design questions at this level included whether the computer can participate actively as the teacher's adjunct in the classroom, or whether it is confined to a passive role as an information source and as a medium for pupils to communicate their ideas.

The middle level - the "view from the tree-tops" - operationalises the ZPD, by providing a generalised descriptive model of the methods which teachers utilise in order to optimise pupils' development. It is derived from Scaffolding (Wood, Bruner, & Ross, 1976), Guided Participation (Rogoff, 1990) and Cognitive Apprenticeship (Brown, Collins, & Duguid, 1988), all of which acknowledge the teacher's role in (a) providing a "bridge" between pupils' existing knowledge and skills and the knowledge and skills to be acquired and (b)

supporting problem-solving through giving assistance while the pupil is engaged in a task. The paradigm at this level is "modelling-supporting-fading": the history teacher models a task so that pupils can build a conceptual model of the processes involved, and facilitates pupils' growing independence in thinking, and in researching, organising and communicating their ideas. Design issues confronting us in this respect included the extent to which the computer can diagnose and remedy shortcomings in pupils' reasoning, and determine when and how to withdraw support.

The bottom level - the "ant's eye view" - focuses on formalising the basic interactions between teacher and pupils. Here the model draws from Conversation Theory (Pask, 1976), by virtue of its premise that a conversation is the minimum necessary structure in order for an entity to be able to understand, learn, maintain and propagate knowledge. Design concerns at this level included the possibility of integrating the pupil's own knowledge and experience into a conversation with the computer about higher-order historical concepts.

This framework has enabled us to adopt a holistic perspective on the field data, to identify which aspects of the teaching and learning of historical causation our proposed software would support, and to ascertain how the program might dovetail with non-computer based classroom activities. Applying the framework has enabled us to produce a robust design document, which has been rigorously validated against the field data. Development of a program to support pupils' causal reasoning in relation to the English Civil War is currently under way in conjunction with a school in Oxfordshire. The success of the framework in contributing to the pedagogical value of the program will be determined through an evaluation of the program by pupils and teachers at this and other institutions. Although the framework is currently an ad hoc one, future work may explore its applicability to the design of software to support reasoning about other higher-order concepts in history and, even, reasoning in other domains.

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