In the Workplace: Learning as Articulation Work, and Doing Articulation Work to Understand Learning

Phillip Kent

London Knowledge Lab and WLE Centre, Institute of Education, University of London
p.kent@ioe.ac.uk

Abstract

This paper offers an account of a methodological approach to understanding and developing learning that has been successfully used in a research project on mathematical skills in workplaces. The approach is based on the concept of articulation work, which is concerned with the processes of coordination and integration by which different social worlds intersect and negotiations take place between them, and the role of symbolic boundary objects as mediators for negotiation.

1. Introduction

This paper is a work-in-progress which involves using the concept of articulation work in the development of a methodological framework that builds on the results of a project which investigated mathematical skills in workplaces, and developed novel forms of learning interventions to support employees in developing new skills.

The concept of articulation work was developed by the sociologist, Anselm Strauss (1993), to account for the under-valued and often "invisible" forms of work (particularly, for him, the work of women at home and at work) which are nevertheless critical to the completion of tasks in everyday life, or in workplaces. In Strauss' terms (cf. Hampson & Junor, 2005; Suchman, 1996), articulation work is the coordination and integration that must go on such that organisational arrangements between the "social worlds" inhabited by people are established, maintained and revised. Strauss (1993, p. 212) defines a social world in terms of there being a primary *activity* (or more than one); *sites* where the activity occurs; *technology* that is involved; and *organisations* that evolve to further one or more aspects of the world's activity. Here "organisations" refers to both formal organisational structures of, say, a workplace, but also the informal structures that evolve amongst employees to maintain the practice[1]. "Interactional" processes are central to articulation work, including negotiating, compromising and educating. Social worlds intersect along "fluid boundaries" which are continually negotiated, and I am particularly interested in the technological and mathematical artefacts through which these boundary negotiations take place.

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[1] There are similarities here to the "cultural-historical activity theory" approach, which we have used in previous writings (Kent et al, 2007; Bakker et al, 2006). In order to keep my thread of argument simple, I will not discuss these similarities in this short paper. (Cf. also Fjuk, Nurminen, and Smordal, 1997.)

In research on mathematical skills in workplaces, my colleagues and I[2] were interested in the role of mathematical skills in a range of workplace types, one of which was customer service call centres for financial services companies, which were providers of pension, investment and mortgage products direct to customers (Kent, Noss, Guile, Hoyles, & Bakker, 2007). Articulation work is central to this work, since it is all about the employee's ability to articulate between the informational needs of the customer and the IT-based information systems which hold the customer and product information.

We found that the articulation work of customer services was very often compromised by a lack of mathematical understanding on the part of employees; indeed, their roles had generally been setup not to require such understanding. This is perhaps not surprising, given the shortage of mathematical skills in the labour market, and the wage premium employers must pay to obtain them. Thus, among the social worlds within a company which interact around the IT system, there has been an intentional system design on the part of managers and financial-mathematical experts such that the mathematical models and relationships used for the calculations within the IT system have been made to be invisible, except to those expert employees.

Why should this matter for companies? The informational needs and expectations of customers are changing; customers want to know more, and this puts a pressure on customer service employees to explain more, which challenges the mathematical understanding of both employee and customer. An example of lack of understanding that we observed involved pension customers seeking information about the annual pension statement which had been sent to them, which contained a projected value of their pension at the point of retirement (see Figure 1). The projection was based on a mathematical calculation (compound interest) that was unknown to the employees; thus they could only provide scripted responses to customer questions (likely not to satisfy the customer), or pass the customer query on to technical departments (an expensive exercise for the company).

Our research involved trying to find means of developing employee understanding of some of the mathematical calculations that featured in the IT systems they worked with. They reported dis-satisfaction in that they perceived calculations as "just magic", and we wanted to replace such perceptions with a solid (although necessarily limited) understanding of what was happening. A need for informal learning presented itself: informal in the sense of being unlike (formal) school maths (any attempt to introduce this would alienate most employees, and fail to take account of the complexities of the workplace context), and drawing on employees' personal experiences and understandings. Informal, also, in that our time with the employees could only be very short, thus we wanted to offer tools and ideas to the employees which would allow them informally to work on changing their own practice.

The key to this approach to mathematical learning is to make use of the "symbolic boundary objects" that form part of practice, that is, the graphs and numerical tables that are the inputs and outputs of the IT systems. Figure 1 shows an example of a pension statement that proves problematic for communication between employee and customer.

[2] Techno-mathematical Literacies in the Workplace project, 2003 – 2007. See www.lkl.ac.uk/technomaths.

Statement date: 24 April 2005
Date of birth: 19 April 1956 Pension age: 60

Your fund at the statement date is: £14,223

Projected benefits at pension age:

	Lower rate (5%)	Mid rate (7%)	Higher rate (9%)
At age 60 your fund would be	£23,100	£28,400	£34,900
This could buy a pension of	£623 pa	£1336 pa	£2337 pa
OR			
A tax-free lump sum of	£5,770	£7,110	£8,720
and a pension of	£467 pa	£1002 pa	£1753 pa

These are only examples and are not guaranteed — they are not minimum or maximum amounts. What you will get back depends on how your investment grows.

Figure 1: A simple example of a pension statement "symbolic boundary object".

We generally sought to adapt and modify boundary objects for the specific purposes of learning, incorporating them within software-based mathematical learning tools and simulations which we designed. In this case, an appropriate mathematical software tool was a spreadsheet (Microsoft Excel) which is ideal for the construction of tabular data, and it allows users to do algebraic constructions through the use of "point and click" formulae, so that explicit algebraic language may be avoided (but it is there if users wish to look for it), and moreover the spreadsheet will do the work of carrying through the algebraic manipulations and calculations for particular numbers. Thus in dealing with pension statements, we asked employees to re-construct a pension statement such as Figure 1 in a spreadsheet, starting with the most simple case and then building in additional details (e.g., management charges of various forms). An additional advantage of the spreadsheet is that it is software which most employees have access to on their own computers, and already use in the most basic fashion for consulting information. Thus we could hope that employees might take on board the ideas we showed them for re-thinking their understanding of mathematics in their routine practices.

2. Learning as articulation work

If work is interpreted as articulation work, then attempting to extend the capabilities of employees through learning interventions can be seen as an exercise in articulation work in which employees attempt to integrate the results of learning into their existing practices. We thus came to use articulation work in three connected ways:

- as an analytical description of how mathematical knowledge and skills become integrated within working practices;

- as a principle for the design of software-based mathematical tools to support learning in workplaces; and
- as a methodological principle for conducting workplace research which may probe into the nature of mathematical learning "in context".

Symbolic boundary objects and their mediation of articulation work play a central coordinating role among all three ways. The third way implies that we as researchers are also doing articulation work, as we bring our social world into intersection with the social worlds of the workplace. In some sense, it is obvious that researchers must do this, but I would like to stress how necessary we found it to think of ourselves in this way, adopting the position of co-developers and co-teachers with company trainers and technical experts, rather than as outside educational experts who ("objectively") observe the situation and deliver a learning "solution".

A telling example of this occurred when we opened our learning sessions with the following short exercise:

> Geoff and Susan book themselves a "last minute" long weekend break in New York City. Going into shops, they find it a bit confusing that all prices are given without "sales tax" added, and then a sales tax of 8% is added when they pay at the till.
>
> In one electronics shop, they find a special offer of all digital cameras with 15% discount. They decide to buy a camera which has an original (pre-discount) price of $250. At the till, the shop assistant takes 15% discount from the original price and then adds the sales tax.
>
> Geoff is not happy with this and complains to the manager: he thinks the assistant should add the sales tax first, and then take off 15%, because that way he will get a bigger discount.
>
> Who is right - Geoff or the manager - and why?

A common employee response to this question was to insist that only one way could be *legally* correct, an interpretation that simply did not occur to us in designing the exercise: "The 8% tax has to be on the price paid, so the customer is not right." In *our* reading of the exercise, we looked through the hypothetical context to what mattered *to us*, the mathematical relationships involved, and understanding Geoff's situation in mathematical terms. This shows that the "why" of the context is as crucial as the "what", and that "mathematical experts" should not expect to understand what matters mathematically in the context, without doing the detailed articulation work of negotiation with the social worlds of the context. And I think it is appropriate to call this articulation work, because researching in workplaces really did involve for us a continual negotiation and a very gradual, emergent coming-to-understand of the context.

3. Conclusions

In summary, the research described here typically involved looking for workplace situations where there are "intended" boundary objects, through which sharing and communicating about knowledge are intended to happen, but fail to happen because of a lack of knowledge in one or more of the communities involved, or an effective means of mediating the knowledge for all. In such cases, we worked on learning interventions which aimed to introduce new boundary objects which: (1) helped us initially to learn about the nature of the (mathematical) knowledge in the situation, and (2) were intended to "repair" the flaws in the situation by introducing new software-based forms of mediation for the (mathematical) knowledge.

I will conclude with a few points about how the methodology described in this paper may have wider relevance for research on informal learning. The articulation work and boundary object approach has strengths in the following ways:

- to make visible what is ordinarily invisible – both to employees/learners and to researchers of learning, which is particularly important for domains of technical knowledge which the development of IT systems tends to render invisible; by introducing a designed symbolic boundary object, you create a need for the employee to *externalise* their knowledge and understanding;
- looking for changes in practice over medium-term timescales as evidence of learning – as the learner seeks to integrate boundary objects with their existing practice;
- to seek long-term sustainability of learning interventions, by engaging companies and organisations in a way that encourages them to take control of what begins as a researcher-led intervention.

What I particularly like about this approach is that there is a continuous, coherent flow from initial observation of workplace practice around symbolic boundary objects, to the design of boundary objects which "capture" the mathematical concepts at issue in the practice, testing these through learning interventions, towards the sustainable introduction of the tools and ideas into workplace training and practice.

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