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# Technology & knowledge: An exploration of teachers' conceptions of subject-area knowledge practices and technology integration

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# Technology & knowledge: An exploration of teachers' conceptions of subject-area knowledge practices and technology integration

## **Abstract**

This paper explores teachers' understanding of subject-area knowledge practices (e.g. curriculum, goals, and pedagogy of a subject area, etc.) and technology integration, through the use of Legitimation Code Theory. Drawing on a major study of a technological initiative in all state secondary schools in New South Wales, Australia, this paper illustratively uses one dimension of LCT to explore the organising principles underlying the key subjects of Mathematics and English, in relation to teachers' perceptions of technology use in learning and teaching. Analysis suggests a 'code clash' with Mathematics and a 'code match' with English might help explain their different patterns of integration of ICTs. The research is novel and innovative in both its use of theory and combining the separate fields of educational technology and sociology of knowledge.

## **Keywords**

area, subject, conceptions, teachers, exploration, knowledge, technology, practices, integration

## **Disciplines**

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Technology & knowledge: An exploration of teachers' conceptions of subject-area knowledge practices and technology integration

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**Abstract**

This paper explores teachers' understanding of subject-area knowledge practices (e.g. curriculum, goals, and pedagogy of a subject area, etc.) and technology integration, through the use of Legitimation Code Theory. Drawing on a major study of a technological initiative in all state secondary schools in New South Wales, Australia, this paper illustratively uses one dimension of LCT to explore the organising principles underlying the key subjects of Mathematics and English, in relation to teachers' perceptions of technology use in learning and teaching. Analysis suggests a 'code clash' with Mathematics and a 'code match' with English might help explain their different patterns of integration of ICTs. The research is novel and innovative in both its use of theory and combining the separate fields of educational technology and sociology of knowledge.

*Keywords:* teachers' knowledge, technology integration, sociology of knowledge, social realism

**Purpose**

A central focus of educational technology research is the integration of information and communication technologies (ICTs) in classroom practices and across the curriculum. Typically, to do this, research in this area examines factors related to the use of ICTs, such as teachers' beliefs, school cultural factors, access to resources, student engagement, etc (e.g. Law, Pelgrum, & Plomp, 2008; Lawless & Pellegrino, 2007). The aim is often to bring together these factors to create a composite 'picture' of technology integration at a school or in a district. These types of studies have done much to highlight the role of such issues, such as the degree of support from school leadership and access to technology resources, but thus far have overwhelmingly overlooked a key dimension of educational contexts: the nature of the subject areas into which technology is being integrated.

The curricular contexts into which technology is integrated is neither homogeneous nor undifferentiated, especially after primary education, and so to understand differences in the

extent and form of integration of technology into classrooms requires an understanding of these differences in subject-area knowledge formations. This paper draws on an approach in the sociology of knowledge to explore the forms taken by educational knowledge of different subject areas in order to more fully understand the ways in which technology comes to be integrated within them. Specifically, the proposed paper aims to contribute to bringing knowledge into the equation through examining teachers' understandings of both different forms of technology and different subject areas, and bringing these into relation to shed light on differential technology integration. The discussion draws upon findings from a major empirical study of a governmental initiative to integrate technology into secondary schooling in the state of New South Wales in Australia, a part of the 'Digital Education Revolution' (DER) that is central to the federal government's current educational policies.

### **Background**

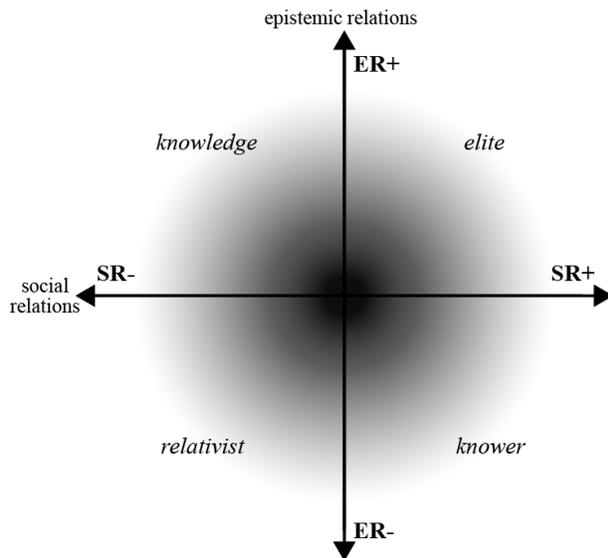
Much of the current educational research investigating technology integration aims to produce a 'holistic' view of contextual factors in order to understand influences on teachers' uses of technology in the classroom. For example, Law, Pelgrum, and Pomp's (2008) major 'SITES 2006' study presents a conceptual framework of technology integration which relates pedagogical practices and ICT use to: teachers' characteristics; school factors; and factors external to the school. Each of these three areas of inquiry includes several sub-factors, such as pedagogical vision (in teachers' characteristics), pedagogical support (in school factors). Though embracing a wide range of factors, this conceptual framework does not include the form taken by educational knowledge (such as whether it is cumulative or segmental, or its rules of sequencing and pacing), potential differences among subject areas, or teachers' conceptions of knowledge practices in relation to technology integration. Educational knowledge is thus conspicuously missing from the picture.

As a growing body of work in 'social realist' sociology of knowledge is showing, the forms taken by knowledge practices play a key role in a wide range of educational issues, from differential educational achievement of social groups to students' subject choices (e.g. Maton & Moore, 2010). Social realist work shows that 'different structurings of knowledge possess different affordances – they lend themselves more to certain forms of pedagogy, evaluation, identity, change over time, and so forth, than others' (Maton, 2009, p. 55). The structuring of knowledge is, in other words, not neutral – different structurings have different effects for practices. Studies in this area suggest that different forms of knowledge may interact differently with different forms of educational technology. However, as yet, the role of structures of knowledge has been largely obscured in studies of the integration of technology into education (Howard & Maton, 2011).

### Theoretical framework

The underlying social realist theoretical framework of the research presented in this paper is Legitimation Code Theory (LCT; Maton, 2007, 2009). LCT focuses on the bases of achievement in educational contexts. To be successful, individuals' practices and beliefs need to embody the dominant basis of achievement to be conceptualized as 'legitimate.' The framework provides conceptual tools for analysing the features taken by knowledge practices. Specifically, this research focuses on the concept of Specialization, which is what makes someone or something different or special (Maton, 2007). Specialization highlights that practices, beliefs and knowledge claims are about or would be oriented towards something by someone. These claims set up both an epistemic relation (ER) to an object and a social relation to a subject (SR), respectively. These relations may be stronger or weaker, thus creating the four legitimation codes of specialization: Knowledge (ER+/SR-), Knower (ER-/SR+), Elite (ER+/SR+) and Relativist (ER-/SR-). These can be graphed and analysed, as seen in Figure 1.

Figure 1. Specialization plane



### Method and data sources

The data presented in this paper is drawn from the New South Wales Department of Education and Training state-wide three-year evaluation of teacher and student use of laptops and other technology in secondary classrooms, which is part of the Australian federal government's 'Digital Education Revolution' in New South Wales (DER-NSW; 2010-2012). One of the key goals of the DER is to promote innovative uses of technologies to underpin all students' learning (Department of Education Employment and Workplace Relations, 2008). In New South Wales, the DER has taken the form of a 1-1 laptop program, providing a laptop for every year 9 student, until they complete year 12.

The DER-NSW evaluation employed a mixed-methods approach, structured in two phases. The first phase included teacher, student and parent online questionnaires looking at ICT access and capabilities, beliefs about the use of ICTs in learning and teaching, and conceptions of quality teaching. The second phase of data collection includes five school case studies, over the three years of the study. Case studies address the same topics as the questionnaires. The evaluation collected data from over 600 secondary schools across the state, which included up to 25,000 secondary teachers and 80,000 students.

The data presented in this paper compares English and Mathematics teachers' questionnaire and interview responses on their beliefs about the use of technology in teaching (e.g. 'How frequently to you use technology in teaching?' and 'Is it important for you to work with technology?' etc.) and the bases of achievement (Specialization) in their subject area, from 2010 and 2012. The Specialization questionnaire item has previously been used to analyze the perceived bases of achievement in a range of school subject in the United Kingdom (see Lamont & Maton, 2008). The tool was adapted for use in the DER-NSW evaluation to investigate technology integration (see Figure 2).

Figure 2. Specialization item on teacher questionnaire

**19. How important are the following things to do well in the subjects you primarily teach?**

|   | Not at all            | Not very important    | Important             | Very important        |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| Having natural talent at your subject area.                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Learning knowledge in your subject area.                      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Learning skills and procedures in your subject area.          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Developing a 'feel for' your subject area through experience. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

The second and third options on the item represent the epistemic relations, while the first and fourth options represent the social relation. Analysis of teachers responses gives us a view of their perception of the form of knowledge emphasized (stronger or weaker relations) in their subject area, which tell us which of these capacities is more important for students to be successful in a subject area. The analysis focuses on differences between English and Mathematics teachers uses' and beliefs about technology integration and Specialization can be used to gain a better understanding of these trends.

## Results

Overall, the teacher questionnaire proved to have a sufficient internal reliability ( $\alpha > .80$ ) in both 2010 and 2012. In 2010, English and Mathematics teachers' questionnaire responses showed significant differences between how often they used computers in their teaching. These patterns were replicated in the 2012 data collection, in regard to how often they were using the DER-NSW laptops (see Table 1).

Table 1. Teachers' use of computers for 2010 and 2012

| Year |  |             | <i>n</i> | <i>M</i> | <i>SD</i> |
|------|--|-------------|----------|----------|-----------|
| 2010 | How often do you use a computer at school?         | English     | 540      | 6.17**   | 2.00      |
|      |  | Mathematics | 491      | 5.68     | 2.27      |
| 2012 | How often do you use the DER-NSW laptop at school? | English     | 362      | 4.86*    | 3.20      |
|      |  | Mathematics | 349      | 4.34     | 3.13      |

Note. 9-point Likert-scale, 0 = 'Never'; 4 = '2-4 times a month', 5 = 'Once a week', and 8 = 'Many times a day'  
 \*\*  $p < .001$ , \*  $p < .05$

Mathematics teachers' computer use in 2010 was significantly lower in 2010. Two years later, the differences in use of the DER-NSW laptops proved to be consistent. When teachers were asked about the importance of technologies in their teaching, the same patterns were visible (see Table 2).

Table 2. Teachers' beliefs of the importance of technology use for 2010 and 2012

| Year |  |             | <i>n</i> | <i>M</i> | <i>SD</i> |
|------|--|-------------|----------|----------|-----------|
| 2010 | It is important to me to work with a computer.                           | English     | 537      | 3.56*    | .64       |
|      |  | Mathematics | 489      | 3.47     | .68       |
|      | It is important for students to work with a computer.                    | English     | 536      | 3.38**   | .66       |
|      |  | Mathematics | 488      | 3.22     | .65       |
|      | I think working with computers should be a fun part of student learning. | English     | 535      | 3.24**   | .69       |
|      |  | Mathematics | 487      | 3.03     | .70       |
| 2012 | It is important to me to work with a computer.                           | English     | 363      | 3.64**   | .57       |
|      |  | Mathematics | 350      | 3.40     | .66       |
|      | It is important for students to work with a computer.                    | English     | 363      | 3.37*    | .70       |
|      |  | Mathematics | 350      | 3.25     | .66       |
|      | I think working with computers should be a fun part of student learning. | English     | 362      | 3.25**   | .73       |
|      |  | Mathematics | 350      | 3.03     | .71       |

Note. 4-point Likert-scale, 1 = 'Strongly disagree' to 4 = 'Strongly agree'  
 \*\*  $p < .001$ , \*  $p < .05$

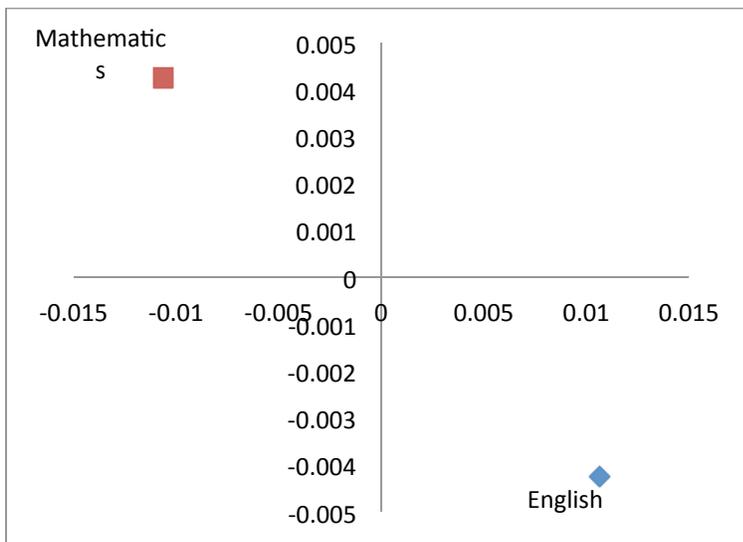
Table 2 shows significant differences in English and Mathematics teachers' beliefs about the importance of technology in student learning and and their own teaching. These differences are

consistent from 2010 to 2012. This suggests that technology integration valued less in Mathematics than in English. Results from the Specialization questionnaire item provide way to understand possible differences between the two subject areas. Figures 3 and 4 are plottings of teachers' responses to the Specialization item, asking them to indicate the base of achievement in their subject area.

Figure 3. Teachers' perceptions of the bases of achievement in Mathematics and English, 2010



Figure 4. Teachers' perceptions of the bases of achievement in Mathematics and English, 2012



Results from both data collections illustrate teachers' perceiving an emphasis on epistemic relations in Mathematics and an emphasis on social relations in English.

Teachers' comments about technology use revealed similar patterns. Mathematics teachers repeatedly stated that 'Maths is about practice, practice, practice' (School 1, Teacher 1); 'you've

got to practice that same thing over and over again' (School 4, Teacher 2). One teacher commented, 'I suppose sometimes the world of the internet is a wonderful thing but we use it in a limited fashion in Maths ... I just don't think we use that or we need to use that as much as other subjects' (School 1, Teacher Focus Group). English teachers highlighted learners' dispositions, such as 'a love of words, of language itself' and 'the stimulation they get from imagery from the written word' (School 2, Teacher 4). English teachers typically described ICTs as useful for providing different ways for students to express themselves. In regard to technology use, one teacher stated, '[technology] gives you a different medium for production ... things like creating your own posters and TV type advertisements, book trailers, things like that and so it's getting them to demonstrate their knowledge in different ways and I think that that's a good thing' (School 3, Teacher 1).

Where Mathematics teachers often used ICTs to provide different ways for students to learn mathematical skills, English teachers typically described ICTs as useful for providing different ways for students to express themselves. These findings suggest there are significant differences in the forms taken by knowledge in different subject areas and that these differences impact upon the degree and nature of integration of technology in secondary classrooms. These findings present possible alignment (code-match) or discordance (code-clash) between knowledge practices in the classroom (e.g. teaching strategies, curriculum objectives, learning resources, technology tools, etc.) and technology use. By using LCT to analyse the principles underlying these practices, the research can show why such integration is successful but also its implications for other subject areas.

### **Significance and conclusion**

The research is novel and innovative in both its use of theory and bringing together the hitherto largely separate fields of educational technology and sociology of knowledge. To date theory has played a limited role in educational technology research. Principally, researchers have used theories of *learning* to design teaching and learning interventions, which are then studied using experimental or naturalistic approaches. The results of these studies advance our understanding of how individuals learn using technology, but seldom theorise the forms of curriculum, pedagogy and assessment within which this learning takes place. The proposed research addresses this gap by drawing on recent advances in the sociology of knowledge that enable different forms taken by knowledge and practice, and their educational contexts to be conceptualised. It thereby offers a theory of knowledge to complement existing understandings of knowing or learning. This represents a theoretical step forward for educational technology research. It promises to offer not only novel insights into the problem addressed by this research but also a new perspective on questions related to the role of technology in education more generally.

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