Researching Teacher Take-up of ICT:
Past Perspectives and Present Day Challenges

Michael Hammond, *m.hammond@warwick.ac.uk*
University of Warwick, Coventry CV4 7AL, UK

Abstract
This paper looks at how research into the use of ICT in teaching and learning has been approached, in particular research into teacher take-up of ICT. It begins by describing two traditions of research: the first with a focus on external or contextual factors which operate on the teacher (a concern for structure in the broadest sense of the word) and the second with a focus on the perceptions and actions of individual teachers themselves (a concern for agency, again in a broad sense). It is suggested these two perspectives have provided a consistent picture concerning the take-up of ICT. However more research is needed into: the changing context of technology use; supporting teachers in making educational decisions about their use of technology; the ecology of the classroom.

Keywords
research approaches; positivism; case study; ICT take-up

INTRODUCTION
This paper looks at how research into the use of ICT in teaching and learning has been approached, in particular research into teacher take-up of ICT. This is an important area for discussion as ICT research has often been seen as narrowly constructed and 'under theorised' (McDougall & Jones, 2006; Underwood, 2004). Stimulated by these comments the paper throws light on the traditions in which ICT research has been carried out, differentiating between research with a focus on external or contextual factors which operate on the teacher and research which focuses on the perceptions and actions of individual teachers themselves. The paper provides examples of these two perspectives, considers what can be learnt from past research and discusses present day challenges in researching teacher take-up of ICT.

CONTEXTUAL FACTORS IN THE TAKE-UP OF ICT
There are many interpretations of the purpose of social research but a recurring goal has been to identify the factors which operate upon people in social situations. Indeed it is the search for causal explanation of behaviour, based on marshalling of data and 'impersonal' interpretation of evidence, that is said to differentiate modernist social science from speculative comment. Thus positivism, or our positivist legacy, leads researchers to ask questions, in the context of the take-up of ICT such as: What are the causes or factors that lead teachers to use ICT? What is the impact of training programmes on teacher uses of ICT? Is the use of ICT associated with age, gender, a belief about teaching? In methodology, positivism often leads to large scale casing, meta analyses, large scale surveys, deductive and experimental hypothesis testing.

A well-established strand of research into the reported take-up of ICT is aligned with the 'standard' form of positivism described above. For example Drent and Meelissen (2008); Hermans, Tondeur, van Braak, & Valcke (2008); Sang, Valcke, Braak, & Tondeur (2010); and So et al. (2012) all seek to identify statistical associations between the disposition to use ICT and 'variables' such as teachers' alignment with constructivist principles (e.g Hermans et al. 2008 in looking at teachers in Belgium) or their orientation to professional development (e.g. Drent & Meelissen, 2008 researching teacher educators in the Netherlands). Positivist research tends to draws on commonly used inferential tests as well as more sophisticated multilevel modelling (e.g. Hermans et al., 2008) and in some cases analyses are backed up or triangulated against interview or other 'qualitative' data (Drent & Meelissen, 2008). Overall there is widespread agreement that teachers with relatively strong constructivist beliefs – and such beliefs are considered to be capable of valid and reliable measurement – tend to use ICT more than those with more instructionist beliefs.

Research in the positivist tradition tends to treat actions as behaviours triggered by external factors, albeit individuals will have differentiated dispositions to act on those triggers. Positivist research tends to take beliefs and attitudes as stable and adequately self-reported, for example it takes seriously the idea of there being a teacher who aligns their practice with social constructivist principles, rather than one who is more likely to employ 'learner-centred' teaching strategies in certain contexts. This assumption is of course highly problematic (eg Kane, Sandretto & Heath, 2002) and it is to better capture the context in which factors affect teachers work that case studies have been constructed.

Case studies are, of course, often assumed to be interpretivist in nature but this can mislead in that a number of case studies on teacher take-up of ICT have sought to uncover the contextual factors which operate on teachers, just as survey research does, but at a local, in-depth, and at times inductive and iterative manner. For example Cuban, Kirkpatrick, & Peck (2001) and Tearle (2003) take the school as a unit of analysis and highlight the facilitators for, and constraints on, teacher use of ICT. Cuban et al. took a 'critical' case, a school in which the widespread take-up of ICT was expected but was not observed. The study exposed the barriers to the use of ICT including curriculum constraints and cultural assumptions about the nature of teaching and learning. In contrast Tearle took another unusual case, a school in which ICT was being used extensively, and identified the factors which enabled this to happen. These factors included: external influences; aspects of the culture of the whole school; and the staged nature of the ICT implementation process.

Case studies allow a more theoretical or at least analytical view of the factors which operate on teachers. For example one 'theoretical' framework which is often adopted, or adapted, to explain and model teacher take-up of ICT is the Technology Acceptance Model (TAM) as in Stols & Kriek (2011). Another framework which has been used to throw light on the tensions created by technology use has been activity theory (Engeström, 1987) as in Demiraslan and Usluel (2008), in examining two schools in Turkey, and Lim & Hang (2003) looking at the dynamics of change in schools in Singapore. In a further study Blin and Munro (2008) look at the uptake of a VLE in a higher education institution in Ireland. They found that while VLE use was widespread, 'disruption' of teaching practices had not occurred - again suggesting that technology had little catalytic potential. There are however criticisms of activity theory and its use in some cases appears formulaic and seems to lead researchers to focus on constraints on change and the limits of agency rather than emergent practice.

There are of course many further studies which explore the take-up of ICT than presented here and several reviews (among others Cox, Preston, & Cox, 1998; Gaffney, 2010; Mumtaz, 2000; Scrimshaw, 2004) have attempted to pull together the literature to present a general view of the factors which encourage (present opportunities for) or discourage (present constraints on) teacher use of ICT. These

reviews show a striking consistency in that access to ICT and the quality of that access; training and appropriate CPD alongside in class support; a culture of innovation; more learner centred attitudes to teaching and a willingness to be proactive or entrepreneurial in career development are key factors in the take-up of ICT. In contrast difficulties of access; lack of support; the hold that pen and paper testing has over the curriculum and intensive workloads are key inhibitors. Demographic factors such as age and gender are sometimes raised but evidence of their influence is far less consistent than the contextual conditions cited earlier.

INDIVIDUAL FACTORS IN THE TAKE UP OF ICT

Social research took what many social theorists choose to describe as an 'anti positivist turn' in the latter part of the 20th century as social phenomena became seen as socially constructed and the potential of social theory to illuminate the 'rules and social practices' which underlay social activity was increasingly recognised (e.g. Winch, 2007 [1958]). This more interpretive stance assumed that individuals could exercise agency in their actions and their actions mattered even if their agency was compromised by their incomplete or distorted understanding of the social institutions in which they acted. Interpretive research takes in a range of approaches including narrative inquiry and life story but at least in educational research the most popular approach became case study (Adelman, Jenkins, & Kemmis, 1976). As seen earlier not all case study is interpretive, but exploratory case studies were able to throw light on how teachers made sense of the world of work and their teaching practices. Research was not so much concerned with the generalizable but the interrelated and the relatable.

In practice many of the case studies in the take-up of ICT are only loosely interpretive and even to this day the stand out interpretive inquiry remains Olson (1988) undertaken in a very different technological world than our own. Olson tracked the use of computers by eight teachers in Canada and was able to highlight the importance of routines as an internal adaption to the complex and indeterminate demands made on teachers. Olson's and similar studies helped show the disruptive potential of ICT and to understand resistance to using computers as a comprehensible and, in many ways, reasonable response.

In some ways complementing Olson's work, Windschitl and Sahl (2002) looked at the use of ICT by three teachers but in a single location, a middle school in USA. One stimulus for this study was to ask whether technology had a potential to develop teachers' practice along more learner centred lines. The study found a complex picture in which adaption to technology was mediated by teachers' beliefs about learners, by what was seen culturally as good teaching, and beliefs about the role of technology itself in the lives of students. The key finding that teachers made differentiated responses to technology was picked up in a further interpretive study of six teachers in a single school in Israel (Levin & Wadmany, 2005).

As with explanatory case studies, exploratory studies generate or test theoretical frameworks and a popular frame of reference in understanding teacher response to technology is that of community of practice (CoP) as associated with Wenger (1998) and Lave and Wenger (1991). A key feature of CoP is the idea that one's identity is not 'constitutional' but develops and changes through participation in practice communities. CoP has had much appeal for those interested in the take-up of ICT. For example Hung, Chee, Hedberg, & Thiam Seng (2005) use the idea of CoP as a framework for understanding types of collaboration, as well as the limits on such collaboration among heads of department in Singapore. In a more general treatment of professional learning, and using an approach that took in narrative inquiry and life history, Hodkinson & Hodkinson (2004) considered the importance of communities of practice in teachers' careers, including the decision to use or not use ICT. They succeeded in showing how self-direction and contextual support combine to affect teacher development. However CoP has been criticised for offering a view of pro-

fessional participation, at least in its early conceptualisation, which does not discriminate between restricted and expansive communities and is weak in addressing structural constraints on individual agency.

Some studies have investigated teacher response to technology across a range of settings. For example Hennessy, Ruthven & Brindley (2005) conducted focus group discussion with teachers in five schools and found an acceptance and openness towards technology but also a great deal of caution. Teaching and learning was seen as heavily constrained but at the same time teachers felt in a state of flux in respect to their pedagogical thinking and showed a readiness to consider new approaches.

DISCUSSION

This paper has presented two perspectives on understanding teacher take-up of ICT: the first focused on contextual or structural factors (the encouragers and discouragers) and the second focused on individual teacher agency and the constraints on that agency. The former perspective offers a more general picture and may appeal better to policy makers while the agency perspective may provide more relatable and critical evidence (Table 1).

Table 1: Summary of two perspectives on the take-up of ICT

	contextual perspective	individual agency perspective
allows us	to see the factors which operate on teachers across educational systems	to see what teachers do or don't do and how they see the world
key insight	consistent picture that factors such as access, curriculum, training, teacher attitudes affect take-up	how and why individual teachers respond differently to the use of ICT and how teacher use is shaped by the communities in which they participate
view of teachers and teaching	more likely to consider teachers as having stable learning styles and preferences	may capture the contradictory and situated nature of teaching
methods	typically large scale surveys, explanatory case study	exploratory case study; teachers presented as cases; ethnography; narrative; life story
theoretical frames	emphasis on structural (e.g. activity theory) or behaviourist frameworks (e.g.TAM)	emphasis on grounded conceptualisation, CoP
of particular interest to	policy makers wanting the general picture	school leaders and those seeking critical appraisal of policy
drawbacks	may present associations with little analytic explanation; may present an over simplified view of teacher actions and an 'over determined' view of activity	small scale and difficult to generalise; may present an overly voluntarist view of teaching; might not capture the wider structural issues of which teachers have a distorted understanding

Both approaches have limitations and it would be wrong as a point of principle to consider one perspective superior to the other for they are showing the same phenomenon from different angles. There are, however, conclusions to be reached as to what we have learnt from past research into the take-up of ICT and how we have

gone about researching it. These are summarised in four arguments concerning: what we know already about take-up of ICT; the changing context; strategies for intervention; and the interplay of structure and agency.

Argument 1: We know quite enough about teacher take-up of ICT in conditions of constraint

We have a very clear and consistent picture of the factors which operate on teachers in deciding whether and how to use ICT including those of access, CPD, curriculum and, to the extent this is possible, the types of teacher who are likely to be proactive in using ICT. From the individual teacher perspective we can see that, even if many teachers are positively disposed to the use of technology, ICT is rarely catalytic in the way that enthusiasts imagine. When it comes to understanding settings in which access is constrained, curriculum is unreformed and the choice to use ICT is de facto voluntary there is not much more to be said.

Argument 2: We need to know more about the changing context in teachers are working

Even if a lot is known about the use of ICT in constrained teaching contexts we know far less about what happens as that context changes, for example when, notwithstanding inequalities of access, young learners and indeed teachers have ubiquitous access to web resources and social networks both in and out of school and invest heavily in their online identities. Not surprisingly teaching has been reported as in a state of flux. Analytical frameworks are needed to make sense of this flux and one proposal is to see the school as complex system in order to capture the dynamic and unpredictable nature of change (Kuhn, 2009). Indeed complexity theory has been applied to understand teacher take-up of ICT, examples include Morrison (2005) and Phelps, Graham, and Watts (2011) in, respectively, schools in China and Australia. Morrison in particular argues that a new form of planning and teaching-team based working with technology emerges as older, isolationist forms are undermined. On the other hand there are difficulties in seeing schools as 'complex' in that they do not face the same imperative to change as commercial organisations and their use of technology does not match the free flowing unpredictable dynamic of, say, social networking.

Argument 3: It is more important to support teachers in making educational decisions than to say how and why they use ICT

Studies have already thrown light on the importance of distributed leadership and the importance of conversations about learning in developing the use of ICT (Fisher, Dwyer, & Yocam, 1996). Frameworks such as community of practice have provided a lens on teacher activity as has Engeström's more recent work moving towards a view of 'expansive learning' which better highlights teacher agency (Engeström, Engeström, & Suntio, 2002). There is strong argument too for adopting a more explicitly interventionist approach and it is no surprise that action research has been a common response to developing teachers use of ICT (e.g. Armstrong et al., 2005; Convery, Mavers, Lewin, & Somekh, 2006; Sutherland, 2004). The virtues of action research should not be underestimated but action research should not be seen as a panacea, the complaint will continue that it provides local knowledge by means of a considerable investment of time and energy.

Argument 4: We need to better understand the interplay between agency and context in the take-up of ICT

Of course the two perspectives given earlier are not exclusive and indeed it is impossible to consider factors which operate on teachers themselves without considering what teacher themselves do to, say, create the cultures in which they work (as shown, for example, in Tearle, 2003). In the same vein, as seen earlier, it is im-

possible to consider teacher agency without being aware that agency is severely compromised by the wider educational system at meso or macro levels. The need to combine perspectives is obvious but, at the same time, methodologically complex for these are alternating perspectives not ones that can be adopted simultaneously. Nonetheless we can present a more nuanced, perhaps a more properly ecological view, of the context in which teachers work. One stimulus here is Gibson's original idea of affordances which suggest that the environment is one of perceptual opportunity rather than objective physical properties (Hammond, 2010). Another stimulus has been that of actor-network theory (ANT), often seen as originating, or at least popularised, in work by Latour (1987). In ANT technologies and humans participate in mutually reinforcing networks and while many have difficulty in the characterisation of objects as 'actors' ANT does present a distinctively dialectical view of the environment as both shaped by human activity and shaping human activity. This suggests that technology is multi-dimensional and Johannesen and Habib (2010) use this perspective to good effect when analysing the use of ICT in three faculties in a university in Sweden. In their study the same technology, in this case multiple choice testing, is perceived in different and perhaps unpredictable ways, depending on the perception of teachers and faculty cultures. The framework is not without problems, for example faculty cultures are presented as surprisingly one dimensional, but the paper does enough to suggest that the more interesting research questions concern perceptual affordances rather than the take-up of ICT per se.

REFERENCES

Adelman, C., Jenkins, D., & Kemmis, S. (1976). Re-thinking case study: notes from the second Cambridge Conference. *Cambridge Journal of Education, 6*(3), 139-150.

Armstrong, V., Barnes, S., Sutherland, R., Curran, S., Mills, S., & Thompson, I. (2005). Collaborative research methodology for investigating teaching and learning: the use of interactive whiteboard technology. *Educational Review, 57*(4), 12.

Blin, F., & Munro, M. (2008). Why hasn't technology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory. *Computers & Education, 50*(2), 475-490.

Convery, A., Mavers, D., Lewin, C., & Somekh, B. (2006). *ICT Test Bed action research reports cross-case analysis December 2006*. Manchester: ICT Test Bed.

Cox, M., Preston, C., & Cox, K. (1998). What factors support or prevent teachers from using ICT in their classrooms? Paper presented at the *British Educational Research Association Annual Conference, University of Sussex at Brighton, September 2-5 1999 [online access at http://www.leeds.ac.uk/educol/documents/00001304.htm]*.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Demiraslan, Y., & Usluel, Y. (2008). ICT integration processes in Turkish schools: Using activity theory to study issues and contradictions. *Australasian Journal of Educational Technology, 24*(4), 458-474.

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*(1), 187-199.

Engeström, Y. (1987). *Learning by Expanding. An Activity-theoretical Approach to Developmental Research*: Orienta-Konsultit Oy.

Engeström, Y., Engeström, R., & Suntio, A. (2002). Can a school community learn to master its own future? An activity-theoretical study of expansive learning among middle school teachers. In G. Wells & G. Claxton (Eds.), *Learning for Life*

in the 21st Century: Sociocultural Perspectives on the Future of Education. Oxford: Blackwell.

Fisher, C., Dwyer, D., & Yocam, K. (1996). *Education and Technology: Reflections on Computing in Classrooms.* San Francisco, CA: Jossey-Bass and Apple Press.

Gaffney, M. (2010). *Enhancing Teachers' Take-up of Digital Content: Factors and Design Principles in technology adoption.* Melbourne: Education Services Austalia.

Hammond, M. (2010). What is an affordance and can it help us understand the use of ICT in education? *Education and Information Technologies, 15*(3), 205-217.

Hennessy, S., Ruthven, K., & Brindley, S. (2005). Teacher perspectives on integrating ICT into subject teaching: commitment, constraints, caution, and change. *Journal of Curriculum Studies, 37*(2), 155-192.

Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education, 51*(4), 1499-1509.

Hodkinson, P., & Hodkinson, H. (2004). The significance of individuals' dispositions in workplace learning: a case study of two teachers. *Journal of Education and Work, 17*(2), 167-182.

Hung, D., Chee, T.-S., Hedberg, J., & Thiam Seng, K. (2005). A framework for fostering a community of practice: scaffolding learners through an evolving continuum. *British Journal of Educational Technology, 36*(2), 159-176.

Johannesen, M., & Habib, L. (2010). The role of professional identity in patterns of use of multiple-choice assessment tools. *Technology, Pedagogy and Education, 19*(1), 93-109.

Kane, R., Sandretto, S., & Heath, C. (2002). Telling half the story: A critical review of research on the teaching beliefs and practices of university academics. *Review of Educational Research, 72*(2), 177-228.

Kuhn, L. (2009). *Adventures in Complexity. For Organisations Near the Edge of Chaos.* Devon: Triarchy Press.

Latour, B. (1987). *Science in Action. How to follow Scientists and Engineers through Society.* Milton Keynes: Open University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Levin, T., & Wadmany, R. (2005). Changes in educational beliefs and classroom practices of teachers and students in rich technology-based classrooms. *Technology, Pedagogy and Education, 14*(3), 281-307.

Lim, C. P., & Hang, D. (2003). An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education, 41*(1), 49-63.

McDougall, A., & Jones, A. (2006). Theory and history, questions and methodology: current and future issues in research into ICT in education. *Technology, Pedagogy and Education, 15*(3), 353-360.

Morrison, K. (2005). Structuration theory, habitus and complexity theory: Elective affinities or old wine in new bottles? *British Journal of Sociology of Education, 26*(3), 311-326.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342.

Olson, J. (1988). *Schoolworlds/Microworlds: Computers and the culture of the school.* Oxford: Pergamon.

Phelps, R., Graham, A., & Watts, T. (2011). Acknowledging the complexity and diversity of historical and cultural ICT professional learning practices in schools. *Asia-Pacific Journal of Teacher Education, 39*(1), 47-63.

Sang, G., Valcke, M., Braak, J. v., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education, 54*(1), 103-112.

Scrimshaw, P. (2004). *A Review of the Research Literature on Barriers to the Uptake of ICT by Teachers*. Coventry: Becta.

So, H.-J., Choi, H., Lim, W. Y., & Xiong, Y. (2012). Little experience with ICT: Are they really the Net Generation student-teachers? *Computers & Education, 59*(4), 1234-1245.

Stols, G., & Kriek, J. (2011). Why don't all maths teachers use dynamic geometry software in their classrooms?. *Australasian Journal of Educational Technology, 27*(1), 137-151.

Sutherland, R. (2004). *Interactive Education: Teaching and Learning in the Information Age*, Full Report, L139251060. Swindon: ESRC.

Tearle, P. (2003). ICT implementation: what makes the difference? *British Journal of Educational Technology, 34*(5), 567-583.

Tearle, P. (2004). *The Implementation of ICT in UK Secondary Schools*. Exeter: University of Exeter.

Underwood, J. (2004). Research into information and communications technologies: where now? *Technology, Pedagogy and Education, 13*(2), 135-145.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Winch, P. (2007 [1958]). *The Idea of a Social Science and Its Relation to Philosophy*. London: Routledge.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal, 39*(1), 165-205.

Biography

Michael Hammond is associate professor in technology at the Institute of Education, University of Warwick, United Kingdom. He has worked closely with teachers, research students and university colleagues in developing the use of ICT across educational sectors. He has written about the use of technology in professional and academic journals and has a particular interest in the research methodologies used in ICT research and in social research in general. Michael has repeatedly argued that both practitioners and researchers should adopt an inquiry approach into the use of new technology and set out their own agenda for evaluation.