School of Social Sciences and Public Policy

King’s College London

MA in Science Education
Summer, 2005

Learning to use Interactive White Boards in the Science Department: a Case Study

Bruno Morais
ACKNOWLEDGEMENTS

This work is not only an individual dissertation, but also the product of family and friends’ encouragement and support, to who I am truly grateful. I am equally thankful for the guidance and reassurance of my supervisor.

My deepest thank you goes for all members of the school where I carried this fieldwork. They have made me feel part of the community since the first day and, for half a year, have never refused to grant my enquiries their own precious time.
**Abstract**

The Interactive White Board is an innovation in schools; a technology that is rapidly accessing every classroom, particularly at secondary level, by its own worth and by the focus in embracing technology that it represents. However, published literature on this specific equipment, as on the adoption of other technologies, is rather more cautious about its real advantages. This study follows the adoption of Interactive White Boards in an apparently typical secondary school, focusing on the science department. The choice of following only one department enables the study to look in more depth into the social phenomena of departmental learning, thus expanding the breadth of research beyond the simple adoption of the Interactive White Boards. Resorting to two social theories, communities of practice and activity theory, the study follows a methodology closer to ethnography than to typical quantitative research. Teachers have been interviewed and their daily practice followed for the period of half a school year, to conclude that learning to use new technology in the classroom is a prolonged process. Additionally, the study also uncovers a very close connection between collegiality in a professional community and the community’s ability to adapt to change; as well as an evolutionary learning curve that relates the familiarity to the given technology to the level of internalization of it as a mind tool in pedagogic reasoning.
# Index of Contents

1. Introduction.................................................................8

2. Literature review.............................................................13
   2.1. On interactive white boards............................................14
       2.1.1. Teachers and technology.........................................14
       2.1.2. The potential of interactive white boards.......................17
       2.1.3. Reservations on adoption........................................21
   2.2. Institutional learning................................................23
       2.2.1. Communities of practice.........................................24
       2.2.2. Activity theory..................................................30
   2.3. Theoretical tools for fieldwork....................................35

3. Methodology...............................................................38
   3.1. Overview and intentions.............................................38
   3.2. Establishing a setting for fieldwork...............................40
   3.3. Design of the study..................................................43
   3.4. Sources of data.....................................................45

4. The study.................................................................49
   4.1. The setting..........................................................50
INDEX OF FIGURES

1. Fig. 1: Visual model of an activity system..................................................31
2. Fig. 2: Activity triangle applied to the process of adoption of interactive white boards.................................................................75

INDEX OF APPENDIXES

1. Appendix 1: Short open-ended questionnaire........................................91
2. Appendix 2: Base schedule for teacher interviews.................................92
Learning to use Interactive White Boards in the Science Department: A Case Study

Bruno Morais
1. Introduction

In the sixties, multimedia arrived in the schools under the form of television and overhead projectors. It was the first time the centuries-old blackboard had any competition. Along with easy copying facilities for every teacher in present times and colourful, full of pictures and drawings, books, this invasion of new media gave the blackboard a very difficult time. But yet, it stood in the wall of every classroom, and in the mind of every teacher and student. The first true competitor was the whiteboard, which is a blackboard made with new materials and with a new colour. More recently, the Interactive White Board (IWB) became available in the late nineties, early twenty-first century. Whether this will be a significant event or not, in the evolution of classroom practices, is yet to be answered.

The Interactive White Board (IWB), however, constitutes a major technical step from the chalkboard and the whiteboard. It is a touch-sensitive board, connected to a projection device and to a computer. It combines the media of the computer, often displaying the same as the computer screen with the typical use of a board. This is done using a special pen that has two functions; either to control the computer from the board, as a “point and click” device or to write on the board as a “typical” board pen. On other models, instead of a special pen, the user’s finger can be used as the “point and click” device, and there are special pens to write with. Thus, one way or the other, we can think of the IWB as a blend of whiteboard and computer screen.

\[\text{The expression \textit{Interactive White Board} will be used repeatedly throughout this dissertation. I shall use the abbreviation \textit{IWB} from now on, repeating the longer term at the beginning of each chapter for ease of reading.}\]
This dissertation concerns the use of IWB’s in a school, observed during a period of adaptation to them. It is primarily an observational study of that process of change. As I said, it is currently unanswered if this change in materials – from blackboards (or whiteboards) to interactive ones – will be of pedagogical significance. This study tries to contribute towards filling a gap in answering that question.

If the IWB is just a replacement of the blackboard, there should be little need for this kind of work. And, indeed, little new knowledge could be found in it. However, we cannot know that before the research is carried out. And both end results (“yes, it is just a fancy replacement”, or “no, it does bring new pedagogical meanings”) would justify this study. In fact, it is being so massively introduced that it seems we are taking for granted that it is a simple, yet useful, innovation. Moreover, given the current emphasis in technology, it is only natural that governments and schools rush to equip their classrooms with the best resources available. Indeed, IWB’s are being introduced at a very fast rate in schools. They are new technology and therefore immediately linked with investment – which, from the standpoint of the general public, unquestionably means improved education. There are few academic studies, however, that substantiate this widespread belief. Little information is available to safely affirm whether IWB’s bring about actual changes, if those changes are educationally beneficial or what is necessary for the changes to really occur.

Firstly, as all other issues on ICT implementation, studies on IWB’s are relevant precisely because decisions on implementation are being taken everyday and almost thoughtlessly. Leadership teams need to know what is truly useful, and how to best bring that into real use in their settings. Secondly, research on introducing IWB’s is
still sparse, and that makes this study relevant as well, in the sense that phenomena need to be unveiled and reported. Most of the available studies, furthermore, are based on surveys and other superficial techniques, thus not probing in depth but chasing scope and statistical significance instead. By taking a case-study approach and continuous observation, I expect to contribute in the opposite direction. Lastly, and maybe more importantly in the perspective I adopted, conditions of practice are changing for teachers. This work intends to investigate that event as well. How do teachers deal with changing classrooms and do these changes implicate change in practice as well? Some literature suggests that IWB’s produce a climate of innovation, but for innovation to happen, some form of institutional learning and adaptation needs to be going on. How does introducing new technology creates institutional unrest and knowledge reshaping, if it does? In this sense, a process is definitely taking place, to which some light needs to be shed.

Because this study is basically a fieldwork on professional learning and change, the main fields of research that ground this work, are on communities of practice and on activity theory. These are social theories of learning, and have proved quite useful in the field to map out events. They also provide a wealth of language to talk about them. However, because I am looking in depth into one change in the work setting (the adoption of IWB’s), I have attempted to bring together some theoretical and empirical work on teachers learning technology as well as review most of the literature available on IWB’s, to which my findings can be compared. A full literature review divided in two sections – IWB’s and learning in work – makes the second chapter of this dissertation.
Having established the relevance of this study and the grounding theories and literature that will support it, it is necessary to plan a research that fits them. As I have hinted above, this project is a case-study investigation. It has also taken a very ethnographic and qualitative approach, as it appears to me to be more suitable to understand the processes of adapting to a new work setting and new work practices. Furthermore, life in schools is affected by a wealth of different factors and is ever changing. I believe that qualitative and reasonably long research is required to understand relations between processes in such complex systems. More detail on how the research took shape and how the project went from plan to existence is found under the title methodology, in the third chapter.

The teachers and the school form a specific context to the research, and that contextual information is needed to understand the results and findings of the project. Specifically in this school, and during the year of the research, a number of events took place that deeply influenced the flow of events. All these are portrayed in the fourth chapter of this dissertation. Alongside the descriptions, where relevant, the grounding theoretical concepts are used to analyze it.

Finally, a case-study should always be careful in its findings. General conclusions may prove too dependent on particular circumstances and turn out not to be general at all. Particular circumstances may also seem to be specific to the case, and fail to appear general phenomena and therefore, at first sight, be insignificant to the researcher when he presents his findings. While I am conscious of these shortcomings, I do feel that there are a number of typical processes and relations,
which should serve both to inform departmental policy and/or planning of future studies in the area. These conclusions form the last chapter of this dissertation.
2. **Literature Review**

This literature review is divided in two sections. The first section is a review of published research on Interactive White Boards (IWB’s) and integration of technology in schools. The main body of literature in this part is related specifically to IWB’s, and I have attempted to be exhaustive. However, mainly on the relations between teachers and technology, I was forced to draw on more general works, related to ICT in general, or with other themes of ICT such as Internet.

The second section expands the grasp of this work. It presents theories of social or institutional learning, and it relates closely to the purpose of this project, as the research focus is on departmental change. The theories that I introduce involve contemporary views on cognition and do not spring from traditional research on education. Their focus is on how social groups, such as professionals, learn and adapt to change. In this sense, they relate to the perspective of this own research work. Although they are not specific to education, they have been tested as perspectives to guide the social researcher to understand mechanisms of community and of practice. In the coming sections, I present them briefly, along with references to a small number of recent studies in the educational field that drew on them.
2.1. On Interactive White Boards

Published research concerning IWB’s is recent and sparse. A first literature review was published this year (Smith, Higgins, Wall & Miller, 2005), and, as the authors are keen to underline, knowledge on this topic is still based in exploratory studies. Those exploratory studies come from mixed sources, such as individual teachers, commercial companies, academic researchers or governmental organizations. Smith et al. covered these distinct sources in their piece and note that “some caution is therefore needed in interpreting the findings” (p.91). The two main motives for caution are on quality of data and research and on possible vested interests behind some statements. It is however clear, from end to end, that there is an aura of optimism around IWB’s and reports are generally positive in their evaluations (BECTA, 2003, Beeland, 2002, Bell 1998, Kennewell & Morgan, 2003).

2.1.1. Teachers and technology

It is a generally accepted fact that teachers’ confidence in using ICT in general seems to be a major influence in its integration in the classroom (Granger, Morbey, Lotherington, Owston & Wideman, 2002, Hennessy & Deaney, 2004, Hennessy, Ruthven & Brindley, 2005, Madden, Ford, Miller & Levy, 2005). All these authors agree that teachers need first to get acquainted with a new technology and comfortable with its use, before they can bring it into their regular practice in a more “sustainable” fashion than one-off displays for external observation. There is no
reason to believe that the same observed for Internet or computers would not happen with IWB’s.

However, there is room for digging deeper. Albion (1999), states that it is not general, all-round, confidence in using ICT, but mainly the feeling of self-efficacy in teaching with technology. As this author puts it,

“Teachers’ beliefs in their capacity to work effectively with technology are a significant factor in determining patterns of computer use” (p.3).

Self-efficacy is a psychological construct more difficult to affect than blind confidence, and thus a teacher’s self-efficacy beliefs are a slow changing trait of his/her practice. It also offers an explanation for the documented fact that teachers will not hastily leave their pedagogic comfort zone (Smith et al., 2005). Bandura (as cited in Albion, 1999) suggests that it is through own successful practice (enactive practice) or through direct observation of successful practice (vicarious practice) that these beliefs change, much more than through verbal persuasion. Thus, teachers, instead of isolated instructional sessions, would prefer alternative learning trajectories such as periodic workshops or informal learning from peers and others. In Granger et al. (2002), as in other works, this seems to be the case. This seems to be in contradiction with the common paradigm of training in technology. The most common paradigm for training in technology, though, is the one-session-only demonstration. These demonstrations fit in the category of verbal communication, not vicarious communication because the teachers do not actually see the use of technology in real context. Or, in other words, they do not witness successful practice but are only told about the possibilities. According to Smith et al. (2005), these
isolated sessions, therefore, serve much better the purpose of fuelling initial enthusiasm than changing practices.

These considerations raise a few themes about ICT integration in the classroom, that are addressed in the literature: time to develop confidence and new resources, collegiality to learn from others and share resources and, curricular flexibility to experiment with new strategies and resources. There have been studies accounting for this long scale change. Mary Ann Bell (2001) re-visited her initial survey on IWB use three years after, talking again to the same teachers. Sarah Hennessy and Rosemary Deaney (2004) also waited three years before interviewing again a group of teachers that have participated in an ICT course. In short, these researchers probed at the effect of time over practice by collecting data from the same teachers with three years interval between initial data-collection and second data-collection. Both studies concluded that time had had a positive effect for teachers’ practice with ICT.

Hennessy and Deaney, furthermore, found that over time, change in ICT use spreads to other colleagues within the department or within the whole school. Kennewell and Morgan (2003), who followed student teachers learning about IWB’s and ICT during their PGCE year, also found a notorious improvement in their subjects’ self-efficacy beliefs in using ICT in class, over that period.

Nevertheless, it is not only a matter of time for integration to happen smoothly, as there are other factors affecting institutional learning and integration of technology. These can be as varied as the quality of ICT provision, changes in staff, perceived pupils’ gains, alternative practices, etc. In relation to IWB’s, a very significant factor for its successful integration is believed to be their physical placement within the
classroom and other – apparently – little practicalities. One significant aspect, mentioned in Levy (2002), on her report of the use of IWB’s in Sheffield to the City Council, is that teachers who do not have an IWB in their own classroom, and consequently need to move the class, are much less likely to use them. Depending on the school policy this may, or not, be a factor, as some schools install only a few IWB’s at first while others furnish all classrooms or a whole department at once. Other aspects such as problems with sunlight shining on IWB’s, positioning of the board at a corner of the room or height of the board, can be off-putting for a teacher just about to trial new approaches (Smith et al., 2005).

2.1.2. The potential of IWB’s

Most scholars address the issue of pedagogic change in relation to IWB’s only superficially. They prefer to focus on the potential benefits of the IWB’s and on a promising new world². More commonly than not, reports are based on observation of exemplary practices or on potential uses of the whiteboards. Based on Smith et al.’s review of literature (2005), these potential uses fall on six themes: flexibility and versatility, multimedia capabilities, efficiency, new resources into the classroom, modelling ICT skills and interactivity and motivation in the classroom.

The first and most obvious potential of IWB’s is its multimedia nature, especially in relation to diagrams and visuals. The quality afforded by this presentational

² As with any commercial technology, potential uses of IWB’s are emphatically mentioned in reports published or supported by companies. However, even scholars who publish on technology are usually scholars keen in using technology, and organizations that fund studies on this area are organizations keen in having more technology used. Thus, a certain bias is unavoidable. In an attempt to be critical and independent, all references in this section come from academic papers and reviews or reports from independent organizations.
technology is more in tune with today “pupils’ expectations in a world of media images” (Glover & Miller, 2001). It is true that multimedia teaching has been praised since the first steps of television, but distance education and television education never quite made it mainstream perhaps by lack of flexibility. Precisely because they are a lot more flexible, computers have brought a new era research on multimedia teaching (see, for example, works on multimedia learning: Mayer & Gallini, 1990, Mayer, 2003).

Secondly, as I already hinted, interactive whiteboards are favoured because of their flexibility and versatility. This feature works in two ways: on one hand, it allows for teachers to change between resources more quickly and to go back and forth easily. On the second hand, “versatility” means for many teachers that it is usable both with modern activities and traditional, “blackboard”, activities. This allows teachers to remain in their pedagogical comfort zone, which they resist to leave mainly because of concerns with classroom management (Smith et al., 2005). To a large degree, the theme of efficiency is connected to versatility and flexibility, when it comes to teaching and learning. Being versatile enough to show videos, emulate a normal blackboard, allow for computer presentations to be shown or allow whole-class use of Internet, the interactive whiteboard diminishes the disruptions caused by out-of-the-ordinary lessons. Thus, a gain in efficiency is perceived, in the sense of less time to do the same thing. Also, computational technology – whose use is facilitated in classroom by the presence of an interactive whiteboard – allows gains in time by “freeing students and teachers from laborious processes” (Osborne & Hennessy, 2003).
In 2001, Margaret Niess related teachers’ knowledge of technology to the different aspects of their practice. She used the terms “pre-active”, “active” and “post-active” to define the different roles of the teacher – planning, in-class and evaluation. Her major finding is that knowledge of technology is especially important in the way it affects planning (pre-active). While it is still an enhancing factor for the remaining roles, it is during prior to the classroom work that teachers think about technology. This is reportedly an accepted view amongst both teachers and researchers (Osborne & Hennessy, 2003, p.29) and it relates to teachers’ confidence in using technology, which I will address later. During planning, teachers decide which resources to use, whether existing or new ones that need to be created, as well as which strategies/tools they will employ for a given pedagogical goal. According to Smith et al. (2005), the time spent in preparing resources does increase initially when IWB’s are introduced. But potentially, it decreases once the adaptation to the new media is completed. And in the meanwhile, as one student teacher from Kennewell and Morgan’s study puts it:

“I also think the lesson would be improved quite a lot, so I would not mind spending extra time preparing the lesson if needed to” (2003, p.4).

In addition, there is no question over the potential to save and share lessons, and that is common to every study. For example, Glover and Miller (2001), as they observed a school that was getting into grips with IWB’s, note that “staff spoke enthusiastically of the way they posted materials to shared document facilities” (p. 271). The more collegial the environment in a school or department, the more this potential for sharing of resources seems to come into reality (BECTA, 2004). Thus, there is evidence of creating and sharing new resources as a side process to IWB use in the classroom.
A final major theme, when talking on the potential uses of an IWB, is interactivity. The sheer expression “interactive whiteboards” provides basis for the claim, but the meaning behind that word, in relation to classroom teaching, is not clear. There should be a distinction between technical and pedagogical interactivity, as Smith et al. (2005) suggest, depending whether the topic is interacting with the computer while teaching, or interacting with the children while using the computer. The emphasis, for these authors, is that whilst the first technical interactivity does little for the children, the second really enhances learning. Along the same lines, Osborne and Hennessy (2003) warn against the use of ICT in the classroom for the sake of it, arguing that ICT is not a pedagogical strategy but a tool to be integrated in addition to other classroom activities. However, the length and value of using technology, and IWB’s in particular, is still far from conclusively discussed. As an example, while some reports mention whiteboards as tools that sustain interactivity in whole-class discussions, others criticize the same devices precisely because they still accommodate whole-class teaching instead of progressive teaching strategies. The argument, sometimes, appears to be only loosely connected to IWB’s, and more around the never-ending discussion of teaching strategies and teaching styles.

More interestingly, interaction with computers (which could also be termed interactivity), is said to be a significant motivational factor for both students and teachers. The first and foremost conclusion in the most recent literature review on the issue was “a clear preference for IWB use by both teachers and pupils” (Smith et al., 2005, p.99). Teachers report almost unanimously that students enjoy these devices and participate more when they are used (Bell, 1998, 2001, Glover & Miller, 2001, Kennewell & Morgan, 2003). Aggregated technologies, such as small electronic slates
or polling devices, can be used in combination to the IWB to further increase students’ participation. However, there are some unmentioned fears of all this enthusiasm being only a “novelty effect”, but because IWB’s diffusion has been so rapid (IWB’s in English schools doubled between 2003 and 2004, according to DfES, 2004), long-term research on motivational gains has not yet been conclusive.

2.1.3. Reservations on adoption

In a certain sense, the implementation of whiteboards is seen, per se, as a step towards improvement, because it is painted as an effort to integrate computers and information technology in the classrooms. Therefore there is the immediate perception that it is an effort in the right direction. However, as with every new technology presented to society, some people argue that it is unnecessary and/or disruptive of the status quo.

The major dispute around IWB’s, in fact, is that they may not be quite as necessary as people say they are. The argument being that they do not bring about any changes in pedagogy, but instead are “glorified blackboards” (Burden, 2002). The literature seems to agree that change does not occur immediately as interactive whiteboards are installed (Burden, 2002, Smith et al., 2005), but there is far less agreement if it happens at all. Gibson (cited in Burden, 2002) presents this level of use as a first of a three-step process towards real educational change. The three levels are infusion, integration and transformation; the first being when technology is forced into the classroom, the second as it becomes a routine tool and confidence levels rise and the third when the affordances of the new technology are explored by confident
users. Hennessy and Deaney (2003) document the same evolutionary process over time, over a three-year period. Their study focused on following-up a group of teachers who had been involved in an ICT training course, designed around small-scale projects. The focus of their follow-up interviews was both the individual development from the end of the training on and the diffusion of practices, or institutional development. The conclusions of that study suggest that indeed change that integrates technology is a lengthy process of continuous improvement.

Madden et al. (2005) make an interesting point in the introductory section of their survey on Internet use in teaching. Current teachers, even the youngest, have not experienced teaching with ICT when they were students. Their apprenticeship of observation has modelled a certain concept of teaching different from what is now expected from them. Surely, it will certainly take time to re-frame their dispositions and beliefs. According to Madden et al. (p.274), it will only be in 2016 that the first newly qualified teachers, who experienced real integrated-ICT teaching as students, will start practicing.

A second point of dispute between IWB sceptics and IWB enthusiasts (Smith et al., 2005) is that most of the uses given to the IWB could be achieved with much cheaper projection devices. However, it is apparent from most surveys and reports that flexibility and ability to interact with the computer while teaching are major advantages, and Smith et al. (2005) state this in their literature review. This seems to be a key factor for the acceptance of the IWB. Thus, comparing an IWB to a projector, even if the only difference seems to be controlling the display from the board, is not an argument standing on firm ground.
In the eighties and early nineties, behavioural views on learning were seriously undermined by growing advocacy of constructivist philosophy. This was not only true in the educational establishment but more generally in psychology and sociology. Key influences to the western thought were Russian psychology, which started being translated and published during the late seventies, especially the work of Lev Vygotsky and his followers (the adoption of Russian psychology in the west is described, for example, in Kozulin, 1986), and the development and broadening of scope of sociology, done mainly in France by the works of Pierre Bourdieu (by the early nineties, Bourdieu was publishing since the fifties decade – see, for a review, Bourdieu and Wacquant, 1992). These influences resulted in the recognition that learning and knowing is fundamentally reliant on – and part of – social practices and constructs.

What follows is a presentation of two perspectives that have, at times, evolved side by side within this same stance. Departing from different scholarly fields – anthropology in the case of communities of practice and psychology in the case of activity theory – they present a balanced view of learning, one that can be used in real settings. Because of their different backgrounds, while the two theories often use different expressions, they share a number of key points and a core perspective. I will put forth some aspects that come across both theories, as they have been the concepts that led my field research.
2.2.1. Communities of practice

Coming from an anthropology tradition, Lave and Wenger (1991) published a seminal work on this idea of learning as societal, bringing about a number of concepts that have been instrumental in later works on learning, and especially on learning in the workplace or within a given community. These authors started by broadly defining legitimate peripheral participation as the process by which newcomers to a given practice learn its proceedings. By doing so, they have decisively shifted the spotlights from traditional formal schooling to learning in a socially significant setting. According to them (ibid, p.35), the intention is to relocate the focus from the individual process of learning to the over-arching process of participating in a social practice. Stating that social practice is an overarching process in relation to individual cognition is a step towards the end of the dualism mind-society. A shift of focus within a paradigm of duality in individual-social, would not serve the same purposes, and therefore the authors state their paradigm of thought throughout the book:

“Briefly, a theory of social practice emphasizes the relational interdependency of agent and world, activity, meaning, cognition, learning and knowing.” (ibid, p.50)

Key concepts of communities of practice

By introducing a new paradigm, several ideas become of key importance, whereas they were previously underplayed. The concept of a community of practice (see also, Lave & Wenger, 1999, Wenger, 1998) was brought to light in order to establish that learning must be understood within the milieu of a group of people, rules and activities that makes sense as a unit. In fact, right as Lave and Wenger start to present
their concept of legitimate peripheral learning, they also start using the expression communities of practice (Lave & Wenger, 1991, p.29). Communities such as traditional tailors in West Africa, alcoholics anonymous and native-american midwives were used as examples in their book. Each of these groups shared a common practice and common rules of engagement with that practice.

As the analyst looks at the activity of the community, the artefacts of that community become equally a matter of study. In particular, Lave and Wenger describe legitimate peripheral learning as the acquisition of access to those artefacts, both physically and cognitively – learners will growingly be allowed to use them and able to use them. In the deeper analysis of communities, by Wenger (1998), artefacts were as varied as company forms, computers or cookie boxes. These artefacts embody functions of the community, both in relation to its practice, as is the case of forms, or to its internal mechanisms, as was the case of a member’s cookie box. Another related concept is transparency, and this is a concept more closely related to the traditional view of learning. Artefacts may be more or less transparent, in the sense that artefacts may be more or less easy to relate to the overall practice.

In equal measure with artefacts, discourse takes up a major role in learning within a community of practice. Newcomers also need to access discourse in two levels – to be allowed to use it and to be able to use it. Indeed, access to the right discourse grants legitimacy to the newcomer and, over time, brings him from peripheral participation to full participation. Some given words and expressions assume a certain meaning only in the context of an activity. They may not even exist outside that community. People identify themselves as members of that community, to other
members and to outside people by using them. For example, a newcomer to an office may address one form by its full name, whereas an old-timer in that office would call it the green form. Acquiring the right discourse is a mechanism of belonging.

Finally, a key idea behind communities of practice and legitimate peripheral participation is the sense of identity, of identity formation and change. A person grows into membership of a community of practice as he/she transforms its own identity towards being a practitioner of that specific activity, and to Lave and Wenger this is the same as learning:

“Learning and a sense of identity are inseparable, they are aspects of the same phenomenon.” (Lave & Wenger, 1991, p.115)

This idea was further developed in Wenger (1998), where he underlines that a wide number of communities interlock in an individual’s trajectory. These intersections, which form the uniqueness of each one’s identity, are sources of tension for a community of practice, but by the same process, sources of innovation and adaptation. Again, learning, knowing and belonging to a community are aspects of the same social activity.

The view of learning that Lave and Wenger present is broadly known as situated learning or situated cognition (see also, Brown, Collins & Duguid, 1989). By arguing that learning and acting on a given context are aspects of the same process, it results that cognition is situated within that specific context. This leaves a door open to criticism about the value of such approach, the concern being that the setting of a study and the findings of the same study are too close related, for the findings to be
sound (Nardi, 1996, Lave, 1993). Critics say that any understanding about formation of identity, production of artefacts or establishment of community boundaries may not be transferable from one situation to the other. The utility of analysing an activity from the perspective of situated cognition is thus questionable, as by definition it is an ethnographic enterprise, specific to a given setting.

Fuller et al. (Fuller, Hodkinson, Hodkinson & Unwin, 2005) have been “exploring the usefulness” of the communities of practice framework to understand workplace learning. They have found most of the key concepts useful in understanding the learning and social practices taking place, if they are seen as tools to ground observation. However, they argue that legitimate peripheral participation, as presented originally in 1991, concerns communities of practice of a certain type, which do not necessarily occur. In particular, for Gee et al. (as cited in Fuller et al., 2005) the argument is that not all communities are stable, cohesive and even welcoming of newcomers. In the book Communities of practice (1998), Wenger addresses this issue raising attention to what he calls economies of power and economies of knowledge within a community. He suggests that granting or refusing access to knowledge and to decision-making negotiates peripherality or fullness of participation. Fuller et al.’s findings also suggest that “experience of legitimate peripheral participation varied widely and bore little resemblance to each other” (p. 56), which seems to reinforce the criticism on lack of transferability, or at least that diverse communities organize in diverse structures concerning access to knowledge and power.
Communities of practice and teachers’ learning

Hodkinson and Hodkinson (2004, also part of Fuller et al., 2005) tried this framework in analyzing teachers’ learning. Their study was based on field observations and interviews, with the purpose of testing the potential of communities of practice as a grounding theory. They point out that it can hardly account for the learning that occurs in a community where there are no newcomers. Their statement is that although learning is still a part of social participation in a community (in their case school subject departments, where all teachers were expert teachers working together for some years), it does not need to follow a centripetal route from peripheral to full participation. Likewise, a community where there are no “experts” would not be fully understood using only this theory.

Adopting concepts of situated learning to teachers’ learning is a natural position, moreover as teachers apparently practice their activity in communities that are easy to define. Putnam and Borko (2000) did a review on the application of situated learning theories to teachers’ learning. Amongst the problems they needed to resolve, was how to define which community do teachers actually enclose their practice in. They have suggested that teachers’ practice and identity is not confined to the classroom, but in several interlocking levels: classroom, school, all teachers and whole educational establishment. Hodkinson and Hodkinson (2004), particularly acknowledge “the significance of departmental cultures and practices in relation to patterns of working and learning in the teaching profession in English state secondary school” (p.29), which is a clear parallel to the concept of communities of practice. They argue that to avoid misunderstandings, only one milieu should be considered a community of practice, while other broader settings should be called fields of practice. In fact, they
proceed to conclude that a tight definition of what are the main community boundaries is a primary condition for a study on teachers’ learning as situated.

Alternatives to communities of practice

Situated cognition, though, is not the only framework portraying learning and knowing as social practice. It is often put in dialogue with distributed cognition and activity theory, other theoretical approaches to social learning, and I shall now direct my attention to the latter. Activity theory sits its roots more visibly in non-english speaking scholarship, namely German philosophy and Russian psychology (Engeström, 1999, Wertsch, 1986). It is also called cultural-historical theory, as it maintains that culture and history are key factors to understand both individual thought and social activity.

In truth, there are many similarities between situated cognition and activity theory, and a number of scholars have been pointing this out (Barab, Evans & Baek, 2003, Fuller et al., 2005, Star, 1996) as the two perspectives evolve. I shall point out some common ideas, which I have chosen to take into the field, in a later section of this review. Indeed scholars from both perspectives often co-publish, and we can find, for example, a reference to Engeström’s role in Lave and Wenger’s acknowledgments in the beginning of their Situated Peripheral Learning (1991). A few papers, on the contrary, have attempted to distinguish them. Nardi (1996, p.40) argues that activity theory bases its analysis on purposefulness of the activity, more in touch with a human understanding of context, in contrast with “the contingent, responsive,
improvisatory emphasis of situated cognition”. The differences between the two parties, clearly, orbit around the problem of consciousness and purposefulness.

2.2.2. Activity theory

Modern versions of activity theory, departing from the initial emphasis on individual cognition are mainly credited to Leontiev and Engeström (Barab et al., 2003, p.200). Leontiev’s major contribution was to differentiate individual actions and operations, and whole system activities. He argued that the whole of a system (a given community, for example) can only be understood in regard to a specific object (in the sense of an outcome), and that it must include analyzing a complete activity, rather than the separate actions that together can lead to that object. Operations, the third category, are small actions that have become unconscious and internalized (a brief discussion on the meaning of internalization can be found later in this chapter).

In the west, Yrjö Engeström supplies a vision of activity that includes concepts of community, social rules and division of labour (1999, 2001), in aggregation to the traditional subject-tool-object trilogy. He built on Leontiev’s idea that a larger activity would need to incorporate factors that were not personally constructed, but societal. The result, the now paradigmatic extended triangle (figure 1), is in a way, the accommodation of the dimensions suggested by situated cognition and distributed cognition.
Key concepts of activity theory

Two interconnected concepts are quite helpful in understanding the above representation as an ever-changing, proactive system: historicity and transactions. More than simply recognizing that each component communicates with the other, the arrows in the model mean that each factor is able to modify any other. Such history of interactions becomes itself part of the system, and that is what is meant by historicity – the present mode of any system can only be understood given some attention to the history of its past modes.

"Transactional thinking assumes that components of the world transact through a dialectic in which both sides continually are transformed" (Barab et al, 2003, p.209).

Activity theorists have found that these analytical systems, unified under a common object, contained tensions or contradictions, which were themselves part of the system, and indeed a major force behind development (Ilienkov, as cited in Engeström, 2001). About contradictions in activity systems, Engeström summed up:
“Activities are open systems. When an activity system adopts a new element from the outside (for example, a new technology or a new object), it often leads to an aggravated secondary contradiction (...). Such contradictions generate disturbances and conflicts, but also innovative attempts to change the activity.” (2001, p.137)

But learning in an activity system is not simply described by resolving contradictions. Drawing on Vygostky’s initial work on formation of higher level thought, learning is mainly about tools (either physical artefacts or conceptual language and signs) exerting mediation between internal and external. Mediation is perhaps the most important idea in Vygotsky’s work and is given quite some emphasis in activity theory too. It is closely connected to internalization, another key concept, which is the process by which an external tool becomes an embedded part of an activity and of thought. A mediating artefact, therefore, is a tool (not necessarily a physical object) that is used by the individual (or the community) to perform a certain task. The conception of the task includes, consequently, the use of the tool, and therefore the two are inseparable. Thought organizes not directly in relation to the task, but to the tool, which is an intermediary. A quite simple example of internalization of a tool would be the example of communication through email – communicating with someone in another place, initially distinct in the mind from writing in a computer screen, becomes one internal representation. Vygostky (1986) stresses the use of language as the vehicle of that internalization, and in the case of communicating through a computer; a phrase such as “I’ll email my friend this afternoon” is the visible side of that internalization.
For Engeström, purposefulness, contradictions and internalization combine together in individual and social transformation:

“As the disruptions and contradictions of the activity become more demanding, internalization takes increasingly the form of critical self-reflection – and externalization, search for solutions, increases. Externalization reaches its peak when a new model for the activity is designed and implemented. As the new model stabilizes itself, internalization of its inherent ways and means becomes again the dominant form of learning and development.” (1999, p.31)

Activity theory has recently been revived, to study quite a varied set of contexts (Chaiklin, Hedegaard & Jensen, 1999, Engeström, Miettinen & Punamaki, 1999) including teachers’ professional practice, and in particular in relation to ICT (Bellamy, 1996, Lim & Hang, 2003, Romeo & Walker, 2002). In all these cases, activity theory provides a holistic view of the process, one that upholds focus on teaching as the main activity. Lim (2002, p.411), states that a cultural-historical analysis shifts “attention towards the whole configuration of events, activities, contents, and interpersonal processes taking place in the context that ICT is used.” Therefore, teachers’ thinking, ICT in teaching and teaching practice cannot be analyzed separately, but as a whole activity triangle – which is a typical vygostkyan approach.
Activity theory and teachers’ learning

Romeo and Walker (2002), in their pilot study, interviewed a number of teachers in a school with a good reputation in using ICT, applying activity system analysis to each of their speeches separately. They found systemic contradictions, in that different members of a community had different discourses about the same activity, a trait of systems that Engeström calls multi-voicedness (2001, p.136). Their pilot study, though, fails to address the whole school as a system – which would be advocated by the theorists.

Lim and Hang (2003), on the other hand, expanded their case study to address different levels of community. Through interviews and field observations they attempted to map the activity of a primary school in Singapore, in relation to the level of integration of ICT in the teaching practices. Their approach focused on the different systems objects and in the contradictions that can be unveiled.
2.3. THEORETICAL TOOLS FOR FIELDWORK

If we produce two parallel lists of core concepts, one from the communities of practice framework and another from the activity theory framework, we will find several coincidences. These coincidences, however, match in terms of core ideas but not quite in terms of choice of words. We will find one theory using the word *interdependence*, whereas other uses *transactions*; we will find in one list *identity and trajectory*, and *historicity* in the parallel one; and so forth. Instead of analyzing in depth each of the parallelisms, in this section, I will present the core concepts that informed my own fieldwork: artefacts, historicity, economies of power and labour, and internalization. In truth, they evolve from the intersection between the two theories.

First and foremost, **artefacts** are a key concept, and a major focus of attention for a field researcher. In the anthropological tradition, from where Lave and Wenger are coming, artefacts are objects that symbolize beliefs and practices. In this sense, they contain the history of a community, up to the present. Or, in other words, in the present, they *reify* (Wenger, 1998) the social habits. From a cultural psychology perspective, on the other hand, artefacts do not only contain in themselves a social history, but they also shape the way people think about a given activity – perhaps in a more resilient link. The word chosen in this perspective is tools, and it also includes words and representations. Intersecting the two theories, I will use the word artefact when it is seen from the researcher standpoint and tool, when it is referring to a shaping influence on people, although they are one and the same in social practice. Artefacts or tools, they can serve different functions in social practice. Firstly, they
can be mnemonic, when they encapsulate a rules, beliefs, etc. (such as meetings minutes). Secondly, they can be operative, when they encapsulate a given operation or action within a social wider practice (in school terms, for example, the IWB’s). Thirdly, they can be psychological or linguistic, when they encapsulate a certain perception on a part of the activity (for example, a community specific word). These three functions, which the researcher should try to unveil in his/her analysis, are extensions of individual thought into social thought, and vice-versa, making them indissoluble.

A second core concept, whose importance is key to understanding any community, is that of **historicity**. Historicity, a word from activity theory, is linked to identity and identity trajectory, in communities of practice terms, but it concerns more than that. It also means that, in order to unveil the dealings of present practice, the researcher needs to learn the evolution of the community. In a way, just like each individual has his/her own identity, and that identity goes through a trajectory, so does the community and the activity it undertakes go through a trajectory – a history of stages. This history of stages, which lives in community records and in each member’s memory (and therefore, in each member’s identity), is full of resolutions of contradictions. Thus, a major focal point of field research is to unveil these past contradictions and how they have been resolved. That can be accomplished by talking to the community members about past events in the system, and, simultaneously, by analysing community records (in a sense, mnemonic artefacts for the community).

In social studies, field researchers always realize how complex is the setting, and how necessary it is to understand the **divisions of power and of labour**, both the explicit and the implicit ones. The two theories are keen to give this concept some
importance. From a social practice point of view, this allows to map the actual activity and its division into smaller actions (which are carried by individuals or smaller groups). It is also paramount to shed light into each member’s trajectories, identities and aspirations. And lastly, it is in itself a record of how the community deals with its contradictions and evolutions. In a sense, this core concept is like a blanket that shapes the understanding of the whole. In activity theory, it is the core concept that spreads through the bottom level of the triangle; and in communities of practice, it is the idea of participation and rules of participation from peripheral to full.

Lastly, the concept that at first sight seems more closely connected to just one of the two theories is internalization. However, I would not say that that is the case. For Lave and Wenger, stepping from peripheral to full participation is a continuous process of transforming one’s identity. If we understand that as a mixture of memories, ways of thinking and ways of acting, then it is precisely the same as internalization, in social cultural words. In the field, analyzing internalization is, therefore, unveiling the effects that belonging to a community or a change in practice within a community affect the way people think: the roles they perceive for themselves and the conception of the activity itself. But just as in any other core concept, this concurs with internalization at the level of the community, as it transforms itself, which Engeström terms expansive transformation.

These four concepts do not constitute a complete theoretical framework, nor they intend to be such. They need the background from both perspectives to be understood. They are, nevertheless, the focal points of my plunge into a community of teachers dealing with possible transformation of their practice.
3. Methodology

3.1. Overview and Intentions

As already mentioned, Interactive White Boards (IWB’s) are being widely installed in most classrooms in English schools. There seems to be little doubt that they are “invading” the classroom settings. Despite minor quarrels on IWB’s value-for-money, or on their pedagogical potential, they have a very strong argument on their side: that of preferred media. They are to the present generation of children what television was to their parents, an object they understand and with which they have no problem to relate to. This is because the way they think is shaped in interaction with these tools, whereas for adults, computer media is an addition to an existing frame of mind. Papert (1993) suggested that computers would slowly transform the way children think and the way schooling is perceived; and Tapscott (1998) reminds us that technology is merely what we call foreign tolls (objects or ideas) that were not around when we grew up. From a historical-cultural perspective, objects shape culture and thought, and it appears to be room to say that computers shape our thought. If we think of objects as tools, then the IWB is definitely a tool for teachers, and therefore, foreseeable to have an effect on how they perceive their activity.

This work started with an interest on how interactive whiteboards can enhance science teaching, but since then it has evolved into quite a different field of study. Teaching in general, and perhaps science teaching more than any other subject, has been a field of bountiful research for the last thirty years. Constructivism, prior
conceptions, conceptual change, learner-centred instruction, formative assessment, inquiry, informal learning, classroom argumentation, science for citizenship, and other terms, have populated the speech of science educators in ways that, in some cases, have not fully reached maturity. Computers, Internet, IWB’s are only a few more innovations the science classroom needs to cope with. It is, surely, a social setting in the move, changing. In which direction it is heading, is difficult to tell. A valuable contribution to comprehend what that will be, in my view, is the understanding of how each of these innovations affect the way people think, both teachers and students. The limited scope of this study, though, will focus only on teachers’ thought.

Thus, it is not the purpose of this paper to list strategies to be used in the classroom, or to test the potential of the IWB’s. Neither it is to theorize on the correct organizational arrangements for successful integration of this technology. Incidentally, these will be mentioned, as a result of field observations. But the main goal is to shed light on the thought of individuals and institutions, as they adapt to a changing technological world. Drawing on activity theory terms, and very closely related to Lim and Hang’s (2003) study, the attempt is to unveil how we deal with contradictions between the old and the new.
3.2. Establishing a setting for fieldwork

As such, right from the start of this project, I have decided to focus on a particular case, which would be a given school science department, where the change was “just occurring”. The method for this fieldwork should be mainly observational, in an attempt to provide a detailed account of the events that take place. It is common in contemporary educational research to portray the researcher as change bearer in a static system, however, given that this particular study concerns reactions to another change factor (the IWB), it would be redundant to include me as an agent.

Fortunately, this original concept evolved into a specific situation where I am a participant as well as an observer. This role in the stage of events, defined from an earlier phase of the study, has led me towards a more ethnographic stance in this project. Besides long, semi-structured, interviews with all members of the department, I have also accessed the school’s documents and artefacts, and observed the everyday dealings of the actors in the department. But more importantly than that, this participant-observer situation (Preissle & Grant, 2004) that I was driven into lasted for half a school-year, with weekly visits to the school, which supported an iterative method of inquiry – repeatedly raising questions and looking for answers.

My stance as participant-observer was based in a position as supply teacher for science, once weekly, at one particular school. The school needed a supply teacher who could cover for a member of the science staff who had asked for a timetable reduction, for personal reasons. As a result, I was introduced in the department as a “peripheral” participant, in the sense that, although not fully a member of the
community, I was, at the same time, participating in some of its practices. In this situation, which lasted from the middle of the second school term to the end of the school year, I had virtually no planning or marking responsibilities and only worked in the classroom. Indeed, my role was peripheral to the point that in the first times, both the rest of the staff and me used to joke that I was taking someone else’s identity once a week.

As the design of this case study took shape, I approached the head of department for cooperation. Interestingly, he was very willing to have his department participating, but surprised that my intentions were not merely to distribute questionnaires and collect them back. His initial fears, followed by other members of the department, were that interviews and continuous involvement from me would be too intrusive, time-consuming and perhaps disruptive of their practice. During the time I was with them, I fully attempted to meet their concerns and adjust my own research to these conditions. Specifically, I have carried the long interviews over several weeks, attempting to meet with teachers when they had free time in the course of their day of work. But more than that, I have tried to gather information over informal conversations during coffee breaks, lunch periods and the kind. Furthermore, in the department I was working with, the lab technicians play a major role in community practice and in some cases have been working in the school for much longer than the teachers have. Although I have not carried out structured formal interviews with them, they have also been a valuable and unique source of information.
Lastly, I guaranteed anonymity from the start to all participants, and therefore, no names used in this paper correspond to reality. I have decided to maintain my initial plan in this point, despite the fact that the teachers were little preoccupied with the issue. In the same manner, the school’s name is also made up.
3.3. Design of the Study

Before “diving” into the field there were some design issues to be addressed. One of them was choice of school. As I mentioned before, because I intended to immerse myself in an environment where “change was just happening”, it was absolutely fundamental to find a school that had just installed IWB’s. This focus in portraying change as it happens, springs itself in the concept of internalization as discussed before. According to Vygostky’s discussion on research methods (Davydov & Radzikhovsky, 1986), the inter-relation between mind, tool and object (which is the analysis of the whole activity) is only possible to observe in its fully extent if it is not internalized. Before internalization, any practice, whether social or individual, is external and explicit (Engeström, 1999).

More than a difficult problem to handle, this was mainly a matter of practicality, given the rate at which IWB’s are being installed in English schools. However, most schools choose the summer break to undertake this sort of changes, as they involve light building works. It is difficult to find a school doing this in the middle of the school year, and I could not find one. Nevertheless, the department subject of this case study had its projectors twice stolen since the beginning of the year, and that had stalled its adoption. I considered this to be a sufficiently good approximation to my intentions – but I would have to take it into consideration and attempt to establish the real extent of that delay.

The concern with being present during the whole cycle of change is also a major point in traditional case-study research (Preissle & Grant, 2004). Although I would
argue that change cycles overlap and that, thus, it is practically impossible to identify the exact ends of one isolated change, I do agree with Preissle and Grant on a different basis. As already said, change is not a sudden quick step, but a process that spreads over a given period – and fieldwork on change must also expand from a one-time shot to an extended time portrait. In this particular research, for example, it is difficult to identify the end of the cycle, and in truth I do not think it has already finished. Further investigation would be needed in order to make this clear.
3.4. Sources of data

A second major theme underpinning fieldwork after methodological design is that of cross-referencing several sources of information (Johnson and Onwegbuzie, 2004). These authors suggest the use of separate methods to comprehend the several layers of data, in what they call mixed-methods research. By working with individuals, in a case-study format, we must always allow for interpretation effects. Mixed-methods research is a strong instrument to quench this, because individuals are analyzed separately in different contexts. In most literature, it is referred as “triangulation” (Preissle & Grant, 2004). In order to meet this condition; it was important that data for this project was collected in the field through varied means, which I will now describe.

Traditionally, ethnographic work is based in observation, and thus that is one of my sources of information: notes from field observation. In the specific case of my work, these notes arose both from participant and non-participant observation, which I do not discriminate. This sort of data provides a valuable insight on each member’s actions and roles within a community, without being subject to their own interpretation. However, it is not possible to access each individual’s purposes and motivations. Bonnie Nardi (1996), in her critique of communities of practice and activity theory, argues precisely that purposes and motivations need to be understood, in order to access the understand the over-arching activity.

A second source of information is school and department documents. Both communities of practice and activity theory stress the importance of analyzing
artefacts to understand the social constructs. Policy memorandums, departmental and school forms and computer files can provide an accurate view of how the community organizes itself. The information in these documents can be both explicit, in terms of regulations and practice norms, and implicit. Implicit information can be, for example, community’s specific language. In Wenger’s *Communities of practice* (1998), forms and other documents play a decisive role in identifying institutional knowledge.

In third place, for the duration of the fieldwork, I needed to develop an instrument that would allow me to gather information about the on-going process of change. Based in the literature, I assume that change is extended over time. Therefore, detailed shots of activity would not guarantee access to all possible information. Despite being present weekly in the school, it represented only a fifth of the whole time, and I was concerned with the events that would go unnoticed to me. For this end, I devised a short open-ended questionnaire (appendix 1) where teachers could describe any recent events related to IWB’s. Initially, I planned to approach the teachers to fill in one of these sheets every fortnight. As I said, though, the department was concerned with the level of intrusion and the time spent in assisting my project. As a result, these sheets were little used and I relied more in informal discussions, as the participants would not perceive them as spent time on my research.

Finally, and perhaps more importantly, all teachers in the department were interviewed in long semi-structured interviews (appendix 2). These interviews were informed by both the literature on IWB’s and the literature on communities and practice and activity theory. Indeed, because the focus of this research project was the
transformation of both the individual and the community, it was important to expand
the scope of the interviews beyond the use of IWB’s in the classroom. Not all
interviews were carried in the same day, as I already mentioned before. It resulted that
previous interviews also informed the next one, mainly in acquiring a better
understanding of the department’s history and activity.

Having four distinct sources of data, triangulation of results worked in two ways.
Indeed, it either confirmed previous data, or displayed dissonance between methods
and/or participants. A very good example of the effect of triangulation was the
analysis of the department’s common computer drive in light of individual interviews.
All teachers described their role as producers and/or consumers of teaching resources
from the common drive, as well as their style of teaching in relation to the IWB. By
checking for authorship in some of the documents stored in that drive, I confirmed the
claims they had made during the interviews. In the case of one teacher, furthermore, I
realized how humble he had been in the interview, confirming, in that case, not quite
his own assertion but an impression I had already gathered in my informal
observations. In a sense, this process of mixed-methods allowed me, as researcher, to
gather more than separate pieces of information. It allowed me to insight the
relationships between them. And the result is not a systematic description of details,
but a systemic approach of the whole.

Both the short questionnaire and the interview structure were piloted before being
used in the research school. To this end, I gathered a group of teachers that worked in
schools where IWB’s were already an established presence. The piloting process was
similar to that of a focus group, where the participants gathered around my devised
instruments – questionnaire and interview plan – and discussed on how these would or not access the sort of events that they considered important and witnessed in their schools. At the end of that process, as a direct result of their comments, the questionnaire was reduced to avoid redundancies and the interview plan was enlarged to encompass issues they raised.

A major strength of fieldwork based research is that it is extended over time, is the possibility to be iterative in the development of our own understandings. In a sense, it is quite like a process of continuously piloting one’s instruments. The researcher is able to refine questions, unveil questions he/she would not initially be questioning or look for answers to problems raised from initial data. This has happened in my research work. Some initial assumptions, such as the definition of community boundaries had to be revised during the project, because of my observations. As I mentioned before, the interview plans changed with every interview, informed by the previous. But, more importantly, being iterative means that every week, the focus of my attention was defined by my analysis of existing data.
4. The Study

This third chapter constitutes a presentation of the data gathered during the fieldwork. Because of the nature of the data sources and the case-study form of the research, I have chosen to arrange the results as a description of the setting, the actors and the key events. By doing so, I expect to facilitate an understanding of the whole process. However, even though being generally descriptive, a good number of entries in this chapter are grounded with analytical concepts, and in most cases, with explicit references to the sources of data.

The structure of this chapter goes, in the first sections, from the school to individual teachers. Starting with an overall summary of the school, its population and conditions, the description shall proceed to the department. The science department of this school (let us call it Hallbran School[^3]) is the setting where the process takes place, and such setting needs to be described both physically and socially.

From the description of the setting, the chapter follows through a series of events that were related to the adoption of Interactive White Boards (IWB’s). While some of the events will be repeated in other school adopting IWB’s, other are unlikely to happen often during this process. The criteria, therefore, was only how significant was their effect on the overall process of adaptation. The intention, in this chapter, is to understand the process as it occurred in this one case study.

[^3]: In the interest of anonymity, as it happens with the names of the teachers, this is not the real name of the school.
4.1. The Setting

4.1.1. The School

The setting of this study is an outer London urban school. Hallbran School is a mixed, comprehensive school, with an overall good reputation in the community. The school houses around 800 students, from year seven to sixth-form. Most of these students live locally and the school is culturally quite varied.

Physically, the school is a rather old building, and classrooms range from old to freshly refurbished. This gradual refurbishment was still on going as I left by the end of the school year. The process of installing IWB’s, not only in the science department but also all over school, was part of this effort. In addition to school buildings, there is considerable outdoor space, where the students spend their breaks.

In the latest years, this school has not been in the best shape, though, and its name has been associated with being a less than desirable school. In fact, as this study went on, the school was visited twice by the HMI’s services, as a result of being under “special measures”. I felt, however, a general desire amongst staff to improve and “pull out” of that status. Staff in this school is, on average, quite young. As I confirmed towards the end of my research, this is mainly due to a high turnover rate of teachers. Indeed, the number of leavers and newcomers was very high, and that was a defining characteristic of school’s and departmental dynamics during this particular school year.
4.1.2. The Department

The fieldwork this paper reports, though, was not based in the whole school, but in the science department. As such, I shall describe it in more detail. In agreement with what is suggested by Hodkinson and Hodkinson (2004), I found that the school’s staff and their practice were grouped in small clusters, often coinciding with subject departments. Thus, both published literature and my initial impressions ground my choice of community boundaries, as being the same as departmental boundaries. Through the long period of the research, furthermore, this definition of community of practice also allowed to understand the position within the peripheral-to-full continuum of all teachers.

The science department in this school is composed of nine teachers and five technicians, some of which part-time. The teachers range from newly qualified to nearing retirement, and cover all subjects across physics, chemistry and biology, including out-of-school specialisms in computers, biochemistry or environmental sciences. They equally cover a variety of nationalities and backgrounds, and the same happens with the technicians. Responsibilities wise, the department is typically structured, having a head of science, a deputy-head and a head for each of the three core strands (biology, chemistry and physics).

Implicit divisions of power and labour within this department are quite democratic, although neither is equally distributed between all members. There is a core of teachers and technicians in the department that feel more identified with the department, or, in communities of practice language, have a fuller participation in the community. Interestingly, though, it does not necessarily correspond to seniority or
number of years in the school. It seems to be more in relation to each individual’s
dynamism and ability to do the required tasks, when we observe the division of
labour. As for division of power, the head was a very dynamic leader, and
concentrated in him all the decisions. As we will see, later in the chapter, this was of
major significance when he left before the end of the year. Concentration of decisions
in one person is also favoured because there is a strong cohesion between most of the
members, and a strong sense of communal activity. In truth, I have not noticed any
rivalries for positions of power, which, must be noted, may not be the case in a
number of departments. Equalitarian division of labour, sense of common activity and
stable power constitute what is called an environment of collegiality. There is no
doubt that that was a strong characteristic of this particular department.

At facilities level, the department is equipped with seven laboratories, three
preparation rooms and one small office. One of the laboratories is newly refurbished,
while all the remaining six are in need of modernizing. Teachers almost always teach
in the same room. Four of the classrooms are situated around one preparation room, to
which the small office is also adjacent. This arrangement makes this room to be more
than a preparation room, also being the department main room and resource base.
Teachers and technicians cohabit in this space, contributing to a strong community
feeling amongst all. In fact, “being” in that room every now and then, is what (to a
degree) defines participation in the community of this department; and those that are
rarely present can be regarded as *peripheral participants.*
4.1.3. The common drive

Having described the physical aspect of the department, it needs to be pointed out that the department is also *reified* in a central computer’s hard drive, which is called the common drive. In this computer, which is placed in the small office beside the main departmental space, teachers have their personal work areas as well. Just as being present in the preparation room is a participation in the community, so is working in this computer, from the perspective of teachers. The technicians often use their own computer, in the main room, which “separates” the two sections of the community. My analysis of the common drive started as if it was the entry point for departmental documents, and the curiosity was developed as nearly all teachers mentioned the common drive in their interviews. However, I now consider the common drive to represent a *virtual* shared space, one that contributes for a shared practice.

Teaching is not only about IWB resources and each visit to the common drive has reminded me of that. There are spreadsheets with students’ results, files to be printed and used as worksheets, files to be printed and then cut into small cards, lesson plans and schemes of work, among other documents. Indeed, displayable documents are not at all a majority. If we exclude *Boardworx*, which is a collection of slideshows commercially produced and a few folders with images, there are hardly any displayable documents. By displayable documents, I mean files that are created for use with the IWB. Nevertheless, there are files that, although originally created to be printed out in paper, can still be displayed and teachers use them in that way as well. Thus, the classification of “displayable” is not a clear-cut concept and also depends on each teacher’s style and taste. It equally depends on the level of ability in using
computer programs and the time teachers can afford to spend preparing their work. Lastly, a good number of the shared resources in the shared area are links to Internet sites and cd-roms, both of which are not actually in the common drive.

What is clear throughout the common drive though, is that it is a working space for a community, as we do not find explanatory notes alongside the files. Resources are there in raw form, and teachers can use them as they decide to. There is no extra information with the images, stating to which part of the curricula they are relevant, or information with Internet links letting us know how they are used in the classroom. This serves both the case of allowing for individual decision-making and for verbal sharing of strategies amongst the teachers. As Steve (one of the teachers) puts it, concerning the quality of the resources:

“I mean preparing resources to go with it can be time-consuming. But if it is just having images, it is very quick. As opposed to covering things up, and cutting and pasting, and answers appearing at the touch of the button” (Steve, interview).

4.1.4. The teachers

Focusing on historicity as a strand of analysis demands attention to each individual actor in the setting in study. I will briefly describe the personal trajectories and roles of each member of the department. In these short profiles, almost all the data was collected from the corresponding long interviews, despite the fact that, as always, my knowledge of the community will affect my reading of them. Having been
a peripheral participant in this department for half a year, this simply could not be prevented.

The head of science, Angus, is an experienced teacher, belonging to the school staff for a long time. Before getting headship, Angus had left the school for a few years, during which he undertook postgraduate studies in IT. Two years ago, Angus was tempted back to teaching, by invitation of the school, for the position of head of science. As a result of his own interests and education, most of the emphasis on using technology in the classroom departs from him. Similarly, most of the support to other teachers, who were trying to cope with the new equipment, was also his field. Angus left the school during my fieldwork, again for a non-teaching position, but curiously, kept some of his influence in the department by emailing reminders of work to be done or visiting his former colleagues.

The most mentioned teacher in the long interviews, when the teachers are asked about using IWB’s, is David, the head of physics. He is admittedly an enthusiast of the IWB, and of technology in general. While other teachers mentioned that they would like to have sound to go with the displaying abilities of the IWB (and in some schools, not yet in this one, that is being done), David brought his own speaker system and installed it himself. Likewise, in every other teacher view, he is the most advanced used of the IWB in the classroom. David left the school at the end of this school year, for a different teaching post, and had only been in the department for four years. Still, he was a central participant in the community, both from the perspective of divisions of labour and power, as in seniority and presence in the physical space that symbolizes it.
Alex, the head of chemistry, is in the other end of the spectrum, in every comparison with David. Alex teaches in the room farthest from the common preparation room and is never present in that physical department. He is “technologically illiterate”, in his own words, despite being able to use a computer for basic tasks. Alex has taught in this school for over fifteen years and decided to retire. While the pressure to innovate and use computers and IWB’s was certainly only a minor factor in his decision, his inability to use the equipment must have rushed in him the will to leave.

So far I have mentioned three senior teachers from the setting under study, and all of them were leaving the school at the end of the year, or even before that. This was a major factor in the everyday life of the department, and of the remaining teachers, two more of the teachers will be leaving. However, it should not be understood that these teachers were peripheral participants by the fact that they were leaving. On the contrary, Angus and David felt that they were perhaps the most pressing influences towards improvement and innovation. In both their interviews, they have left quite clear that this was not mere professional ethics, but a personal interest in using IWB’s. For Angus, the head of science and with a postgraduate degree in IT, it was also a personal challenge to re-shape the department’s practices for the new times.

The second in department, Arlene, belongs to the group of teachers that are going to stay. She is a biology teacher who has been working in Hallbran School for over ten years, and she justified her stay in the school as being close to her home and her “local school”. In relation to technology and computers, Arlene does not consider herself an expert. Like Alex, the head of chemistry, Arlene’s classroom is far from the
common room. However, her role in the community is quite more active, and that is in direct relation to the time she spends coming over to the department’s base several times during the day.

Suzanne is the head of biology. Like Arlene, she describes herself as a competent but not advanced user, portraying her abilities as ranging from word processing to use of databases. Her first remark about IWB’s, when this fieldwork started, was that she did not use them as interactive ones, but during the time of research, that proved to be only lack of confidence in her own abilities. She has been in the school since her training, twelve years ago, and has never worked in any other school. Like Arlene, Suzanne considers Hallbran School her local school and is quite settled in her post, despite the fact that she would prefer less seniority. However, being in the school for so long, and for most of it with the same colleagues, these two teachers have merged their own goals with the broader interests of the community (both department and school). This results in a compromise between individual and social projects. Such compromise is one of the traditional tensions in analysis of communities of practice or activity systems. In Arlene and Suzanne’s profiles, a second tension comes up. This is the compromise between a stable and constant \textit{habitus} and a continuously changing one.

Katherina is another female teacher with more than ten years working in this school. She re-trained to become a teacher when her children grew up and has now reached retiring age (she has actually became a leaver as well, having decided towards the end of the school year). Her original education was in Central Europe and therefore quite foreign to modern English schools. In fact, she even considers her
PGCE, taken fifteen years ago, foreign to some of the aspects of present times, amongst which technology. She finds herself a very basic user of computers, summing up her abilities in word processing and more recently keeping records with an e-portal in the school. In addition, Katherina was on leave in the first term of the year, and came back to the school to find out teachers quite adapted to the IWB’s and the training sessions already passed. Because of both these reasons, Angus and Suzanne helped her quite a lot:

“So what I have learnt was one my own and with the help of people that did know, here in the department. Angus helped me a lot, and so did Suzanne. I mean, now I am very confident in using the programs that we have available. I mean, I know what is there, and I tried it and adapted it to my lessons.” (Katherina, interview)

Lilly and Steve are new teachers to the department, by comparison to Katherina, Suzanne and Arlene. During this research, Lilly was in her first year of work as a teacher, after her PGCE, but she was working in education already as environmentalist in a children’s centre. Asked about her confidence with computers, Lilly stated that she was probably in advantage to other teachers, because she already learnt with computers, and used them throughout her graduate studies. However, she had no experience with IWB’s during her training, which occurred in 2003/04, and in that sense, she was in the same starting step as the others. Lilly’s participation in the community is quite peripheral, as she is still in a steep learning curve of her new occupation. At the same time, however, she is a full participant when it comes to this particular action (learning to use IWB’s).
Steve was in his third year in Hallbran School and in his fourth year of teaching. He is a foreign biology teacher, and decided to leave the school by summer, for further travelling, quite early in the school year. Like most of the teachers in their interviews, Steve played down his computer skills, arguing that he did not grow up with them. However, he also said that his role, in the department implicit dynamics was to the help other teachers. From my weekly observations, I came to realize that Steve was an important source of information about resources (especially internet links) to other teachers, mainly the rest of the biology teachers. Despite his apparently little take in the division of power within the department, Steve is a member of the community in full.
4.2. The School Year

What follows is a short account of the events that have affected the department during the period of this study. In truth, some of them have taken place before the study actually started, but in this school year. On these ones, the data available is shorter, and I rely mostly on the interviews with the teachers and a few scattered documents. Whereas, on the events that are described that have taken place after I started my fieldwork, I rely as well in valuable direct observation.

Despite the fact that some specific events are highlighted in this section, there is no intention of presenting them as the single influences in the process of adopting IWB’s. Using this equipment in teaching is expected to be an everyday task for the teachers and therefore, significant influences on their practice can happen at any point. As a matter of example, I would point out a conversation between two teachers that, having started on a missing computer file, resulted in a talk about the better way of naming new files in a quickly expanding common drive. This was a lunchtime conversation, in the common department room and other members joined in. This sort of episodes, resemble the process that Engeström (2001) calls expansive learning. They illustrate the period of time when new practices are being brought to the community and they are made explicit, before the members of the community internalize them again. During my fieldwork I have witnessed a number of such episodes, which would go unnoticed in the interviews. Furthermore, the questionnaires (appendix 1) were on occasion repositories of those episodes that I could not directly observe. For example, Suzanne depositing in the common drive every material she could gather in conferences she attended; Lilly adapting her use of
the IWB not having the proper interactive pen, which remained unreplaced for two months after it was lost; or Steve experimenting with having a group of students working on the board while working with others in a different part of the room. Again, these episodes are part of a continuous process of experimentation and adaptation. It was interesting to find that different teachers focused on points of different nature, in their questionnaires. Some teachers focused on strategies that included the IWB, whereas others focused on the use of a specific software or image. Interestingly, there seemed to be a correspondence between ease with technology and the focus on strategies.

As significant influences, I have chosen six separate events. Starting with the installation of the equipment and official IWB training sessions, this section continues to the department’s actions that were related to IWB and to the effect of having special external inspections in the school. Lastly, half the population of the department decided to leave Hallbran School during this year, and those events also affected departmental life in general, but also the process of adapting one’s practices to the new boards.

4.2.1. Introduction of the IWB’s

The first obvious major episode towards adoption of the IWB’s was the installation of the equipment itself. This happened during refurbishment works in the department, which took place in the summer break. The process seemed to have run quite smoothly, although there must have been some discussions concerning the position of the boards in the classrooms. This is because, before the works started, the
teachers in the department decided that they did not want to loose their traditional boards (which were already whiteboards, instead of chalk, blackboards). When necessary, as in the case of Lilly’s room, the existing whiteboard needed to be dislocated, to accommodate for the new equipment. In Hallbran School, most of the rooms are different from the others, and individually making the arrangements to have two boards co-existing was probably a complex task. At the time of the my interviews with the teachers, about six months after the start of the year, most of them had some sort of problem with the solution found for their rooms. Lilly’s old board was too high and too much to a corner; Katherina’s IWB was too low for the back students; Steve’s whiteboard was behind his desk, etc.

From the point of view of the teachers’ adoption of the IWB, though, this event was external to them and thus, I consider it previous to the process. As such, I shall not extend my description of it. Moreover, having not been present myself, nor the teachers in my interviews, I have insufficient data to further this.

4.2.2. Departmental meetings on IWB’s

The second significant event of the school year, concerning IWB’s, was the first INSET day. By this time the teachers had the IWB’s for some time already, but no training on them. As such, the school allocated this INSET time day for internal, departmental, training. In the case of the science department, the procedure was to split the teachers in small groups who worked on different types of resources and different year groups. After some exploration, the whole department met again, so that each group could share their findings.
“What we did, some of us split into groups looking at possible things. Some at the Internet, others for resources we already have (...). And a lot of useful tools came up, most of which were the first time I got introduced to.” (Steve, interview)

The teachers are unanimous in saying how useful this work was. For some, it was valuable in the sense that they were first introduced to new strategies and resources that were beyond their working knowledge at the time. For others, like David for example, it was a possibility to spend some time exploring, which he complained he didn’t have enough. The end result of this INSET, therefore, was twofold. On one hand, the resources base of the department was enhanced and enlarged. This is very noteworthy, more yet if we consider that the teachers had their IWB’s for only a short time by then. On other hand, and just as importantly, it set a standard of sharing practices between the members of the community and the idea that the researching of resources was a common activity in the department. Such activity is supported by an artefact, the common drive, and by the high level of collegiality in this group. However, against Angus initial plans, setting aside INSET days or half-days for this process was not repeated.

“I guess the idea originally was that we would that periodically, but as for all laid plans, other things get put in front, especially this year.”

(Angus, interview)
4.2.3. Supplier’s training

On the purchase of IWB’s, a school is offered training by the company. This supplier’s training is composed of standard sessions, although there can be different levels of skills involved. It appears however, from the teachers’ interviews, that the sessions’ worth was debatable. The main reasons for that was the short time of the training and the inadequacy to the needs of the teachers. However, not all teachers agree on this view. The fact is that the training sessions – two ninety minutes sessions in different INSET days – took place well into the school year, although still in the first term, whereas the IWB’s were in the classrooms since the beginning of September. As a result, depending on teachers’ willingness to find out by themselves and general computer proficiency, the audience of the training sessions was quite varied. With Lilly’s and Arlene’s statements, we can easily perceive this:

“It was just an hour, or an hour and a half. She came in and shown a few bits of what people could do. Some of which, you know, people would have no clue of what they were doing. Whereas we had been using it for quite a while, and we weren’t learning anything there. We were quite bored actually.” (Lilly, interview)

“Oh, I found it really fun. Using the pen and the Activ Studio, with those shapes and hiding bits and that. It was really good as far as showing what we could do with it, so I came out of it more comfortable. But I don’t know if I came out able to do that stuff myself.” (Arlene, interview)

This event, therefore, rather than really training teachers, served as awareness rising sessions. For many teachers, their knowledge of the affordances of the IWB
was very limited. And this training expanded their possibilities. As some teachers have mentioned in their interviews, having the board available on their room puts some pressure on them to use it. If their knowledge of its use is limited and no support is given to them, this is a source of anxiety. The INSET training, no matter how short it is, kindled their enthusiasm to explore. However, this sort of typical “class training” seemed to add little to the actual skills of the teachers, as we can read from Arlene’s view. Most of the teachers have suggested the same, and Angus even said that he did not expect his teachers to get much from the sessions.

In the case of the Hallbran School, however, this amount of time between the installation of the IWB’s and the suppliers’ training was not as visible as, possibly, in other schools. That is because in this school, there were two break-ins, with a short interval between them, where most of the projectors were stolen. However, these thefts also contributed to an uneven distribution of skills amongst the teachers as some were deprived of their equipment and others were not. Those that retained their IWB’s did not interrupt their own self-learning, and arrived at the training, in November, with nearly two months of “messing about”.

Secondly, the training sessions had a social aspect to it, that of enhancing a feeling of common learning. Whether “bored with them” with the session or “enthusiast about them”, all the teachers present in the sessions were in the process of adopting the IWB’s. This generated some curiosity in finding out where the others were at, and what they were trying in their classrooms. In a sense, it formed an extended community of learners. However, the training was not subject specific, and there were teachers from all subjects present, which reduces this effect.
4.2.4. The HMI inspections

As I already explained, Hallbran School was in the process of improving out of “special measures”. This process includes having specific inspections that focus on improvements in the school. The label of failing school and the inspections themselves put an enormous pressure on the teachers, towards change in their practices. Moreover, having the IWB’s installed in their rooms, the teachers also felt “obligated” to use them by the sheer financial effort it represents. Thus, all teachers were, at the beginning of the year, keen in showing results, which means, being able to make some use of the IWB. However, it was a very superficial use, merely with the intent of having the equipment displaying something. In some cases, apparently, the boards would be used only to display the lesson objectives. In this manner, they are obviously no improvement to overhead projectors or standard boards.

“Well, at the beginning, we didn’t have Boardworx, so we used it more just to show our ‘walt’s’ and our ‘wilf’s’.” (Lilly, interview)

When the inspections came along, though, the teachers needed to show “effective use of IT”. This was, indeed, one of the major faults of the school in their previous reports – the poor quality or absence of IT use in learning. Angus, the head of science, was fully aware that there needed to be a conscious and strong effort to change this, and how important that would be in bringing the school out of inspections. Consequently, there was an active effort towards improving all teachers’ abilities with the IWB’s as well as their working knowledge of resources. Admittedly, lessons during inspection days are exceptional in terms of sophistication, as several teachers pointed out, but nevertheless, they fuelled a learning process that could be much
slower in different circumstances. They served as enactive practice, which is the process that affects the self-efficacy concepts of each teacher more efficiently.

### 4.2.5. Loss of the head of department

I have mentioned before that Angus, the head, was the more experienced user of IT in the department. In the terms used by Glover and Miller (2001), he was the main *missioner* toward establishing a stable use of IT and of the IWB’s. As head of department, he also felt it to be his responsibility, not only a personal interest. Therefore, his departure at the end of the second school term, removed from the community one of the members that was more bringing more expansive unrest to it. Even after leaving he was still an influence on occasion. As a matter of example, in one email to all teachers, he listed a number of points. Amongst suggestions for dealing with coming exams, and other matters, there was a point on resources for IWB that Angus had left on a cd-rom and forgot to show to everyone before leaving.

Most teachers referred that the enthusiasm over IWB’s and the learning process were put to halt, as other matters became more pressing. Apparently, the “other matters” were mainly the end of year exams, which started affecting the teaching and learning process since the middle of the second term. Angus was mainly talking about the exams, when he said, “other things get put in front”. With exams preparation, the emphasis in the department’s activity shifts from teaching practices to sheer test results. That, on top of absence of enthusiastic leadership, shoved innovative lessons to a lesser degree of urgency.
4.2.6. A community in regeneration

I conclude this account of the school year focusing on the number of teachers leaving the department. More than half of the teachers are leaving, and only four will stay in the school for the coming year. And curiously the same is happening with the technicians of the department. By the time my research was over, not all of the teachers had been replaced, but most of them had. Moreover, the new teachers coming to Hallbran School will be arriving to positions of seniority within the department. This will certainly mean a whole community of practice in regeneration and would be very interesting to follow up.

A community of practice, or a activity system, define themselves mainly on rules and habitus of its members, on their roles in the whole activity. Only in a lesser degree its actual members define the community. However, the systems are not static and are open to change. The inclusion of new members will start a two-way learning process. Some questions arise, such as “Will the collegiality and level of sharing be maintained under new leadership? Who will assume the role of missioner in furthering the department’s use of IT?” But, on the whole, the new members will certainly be taught and teach at the same time.
5. Conclusions

Different sorts of conclusions can be drawn from this study, whose relevance will depend on the reader. From the perspective of teachers, educational researchers and school leaders, the most important aspect of the study is how the adoption process went on, from a practical point of view. In as much as a set of tips, a case study like this is quite limited. This is because certain aspects of the context of this case are far from replicable. For example, most departments will not have a head with a postgraduate degree in IT, or most schools will not be facing introduction of Interactive White Boards (IWB’s) simultaneously with pressure to improve, brought on by “special measures” and external inspections. However, not all of what happened is specific to this school alone, and some conditions can and should be copied. Other conditions, such as massive turnover of teachers in the same year, on the other hand, can and should be avoided. The first section of this chapter will therefore, focus on the findings that relate to the practical aspect of the process. This is mainly how collegiality and sharing of resources is key to a successful adjustment, and why.

This research, however, grounds itself in a very sociological and analytical theory of professional communities’ dynamics. The data in this case study is worth a thorough analysis of the process from this theoretical perspective. Specifically, in the area of activity theory, there is emphasis on tensions, on institutional learning, and on how institutions resolve tensions expanding their knowledge and practices. The second section of this chapter constitutes an activity theory analysis of the use of IWB’s. From the use of this theory as a foundational aspect of my observation, I reached the conclusion that moving on from using traditional boards to IWB’s is a
staged process, depending on the level of internalization of the new tool. These stages depend on the proficiency of use of IT in general, but even more in how embedded in one’s pedagogical reasoning is the use of IWB-enabled resources.

Thirdly, another section of this chapter will compare some aspects of the literature used in this research with the data collected by myself. Albion (1999); Glover and Miller (2001, 2002); Hennessy and her collaborators (Hennessy & Deaney, 2004, Hennessy et al., 2005); as well as others, have made claims that may, or may not, be true in this particular case study. I will likewise contrast the process that went on in Hallbran School with the literature review on IWB’s published by Smith et al. (2005). This being a case study, it has no intentions of contesting those claims, and indeed, they have been mostly verified. However, when it is not the case, it is necessary to understand what really constituted a difference.

Lastly, as part of the continuous research endeavour, and especially because this is a tentative case study, a few ideas need to be put forth for further research. These thoughts are in part a critique of the present project. The remaining, however, are lines of development for some of the questions that were raised.
5.1. On collegiality

I have emphasized this before, and truly consider it to be a very important trait of the specific case of this study. Most of the teachers in the science department of Hallbran School were old colleagues with good personal relationships and professionally cooperative. It should be expected from the start that this condition greatly affected the process of adoption. And, from both the independent data collected in my observations, and the teachers’ own opinions, it has.

On one side, collegiality, which I defined mainly as the existence of equalitarian divisions of labour and of a sense of common activity within the department, has a positive effect in the process of adaptation to change. When researchers refer to collegiality they often register it depending on the sharing of resources and efforts. This is of immense value when it comes to adopting IWB’s. As the analysis of the common drive revealed, even in departments already sharing computer-stored resources, frequently these are not displayable resources. They can be, for example, worksheets, but IWB’s require a new range of things, mainly pictures, Internet links and slideshows. This is major effort for independent teachers, lengthy as the curriculum is, but a cooperative group can tackle it more efficiently. It was certainly the case, in Hallbran School, perfectly exemplified in the first INSET day the teachers had.

Furthermore, authentic collegiality differs from having specific meetings for exchange of resources and ideas. At the end of the day, discussing strategies and sharing resources happens more often in unscheduled conversations. When the
teachers were asked how the process of sharing really went on, they all replied that most of it was on a “needs basis” – they would either approach someone who they thought could find a given resource useful, or they would approach someone with a specific need in mind, looking for help for themselves. This is only possible if each teacher sees his/her colleagues as cooperative colleagues. Collegiality also contributes to make the teachers feel supported. This means that teachers can approach their colleagues for help, but also that they are at ease to experiment in their classroom, that they can discuss those experiments, no matter how successful they were and that they cooperate with each other in expanding their expertise.

As most literature on teachers’ learning states, when collegiality is high in a professional community, adjusting to new working conditions becomes easier. The absence of suitable teaching resources and consequent need for them is not a new episode, exclusive to the introduction of IWB’s. It occurs when the curriculum is changed, or when new technologies are brought to the classroom. And that has happened before, with the appearance of the overhead projectors and video recorders (see, for an interesting example on adjustment to “audiovisual materials”, Torkelson and Driscoll, 1968).

If we consider a subject department as a community of practice and an activity system, moreover, then teachers are parts of that system. They constitute the system and talking about systemic change is also talking about their change. If the parts of the system are flexible towards each other, which depends partially on how cooperative they are (again, the level of collegiality) the whole will more easily be flexible as
well. And, by force of reason, if a system is more flexible it will more rapidly adjust to new conditions.

Secondly, there is a reciprocated effect between the introduction of IWB’s and collegiality. The absence of suitable teaching resources for the new equipment at the beginning of the year placed all teachers in the same position, even if they were at very different levels of proficiency with the use of computers. They were therefore impelled to cooperate, and that need was made real with the first INSET and the training sessions. From this case study, it is difficult to say what would happen in a school where originally the teachers kept to themselves and their classrooms, but what seems to be the case is that the levels of cooperation rise as the need occurs.

This feedback process between pressure for change and collegiality falls very well under the concepts of historicity and internalization. Historicity because past events and the strategies towards the resolution of conflicts become part of the system characteristics. At the same time, becoming part of the system themselves, these strategies are being internalized in its practices. In the future, the department would be likely to deal with pressure for change more easily. However, from the data available to the end of the school year, it is far from clear when the process is close to resolution or even if it will ever be. As an important note, however, I feel that with the accumulation of pressures, which were evident in this department towards the end of the year and especially since the head of department left, there is the danger of stalling an expansive learning process. Teachers were quite aware of this, as David described:

“But it has stepped to a level and it didn’t develop any further after that initial drive. I think what people wanted was, since they were
installed, they wanted the school to see they were being put to use. Maybe not as much developed as it could be, with programs and interactively, but being used anyhow. If they were just left there and not used, the teacher would certainly look bad. Once they were safe on that side, teachers moved on to other issues.” (David, interview)
5.2. Learning to use IWB’s as expansive activity learning

From an activity theory perspective, any practice or community activity can be understood using the several interlinked concepts that I have presented in the literature review of this study. These are the points in the activity triangle; subject, tool, object, goal, division of labour, community and rules. The activity needs also to be understood on the basis of existing conflicts or tensions within each node and between nodes. My reading of the situation, which serves as a basis for the rest of this section, is depicted in figure 2. The key point of this conceptualization is with what sort of object do the IWB’s, as tools, enabled the teachers to interact with.

Fig. 2: Activity triangle applied to the process of adoption of IWB’s.
As with all teaching resources, the IWB is an internal mind tool for the planning of teaching strategies, as much as it is a real tool for the process later in the teaching activity. Whether constantly present in the mind during that planning is a different matter and that is actually an indication of how “internalized” the learning of it is at a given moment. The type and variety of strategies the teachers can imagine for their lessons, resorting to the IWB, should likewise be a measure of how deeply embedded their pedagogic reasoning is with this tool. In fact, the shift from describing the use of IWB’s as a series of resources (be it images, slideshows or educational cd-roms) to more complex pedagogical situations (in which the IWB is not the centre piece but a transparent tool) constitutes a stage of learning.

As with any other tool, the IWB affords different levels of use, depending on the proficiency of the user. Most tools, either physical or conceptual, allow for more than one use, and the variety of usage rises as the subjects develop their familiarity with them. With different levels of ability of use, it results that the IWB becomes a tool related to different levels of pedagogic thinking.

To a certain extent, although managed internally not to become a disruption, the introduction of the IWB in a school is a “back to the basics”. During the adjustment phase that this study witnessed, teachers tend to be more didactic. Truthfully, there is an enhanced visual aid to this didactic stance, but it is still a quite one-sided teaching approach in the first trials. With increased confidence and familiarity, though, other uses of the IWB become possible and teaching with the new tool develops interactivity. The references in the teachers’ accounts to using graph programs or to start experimenting with simulation programs are clear indications of evolutionary
process. But before this happens, teachers need to be confident in the most basic of teaching strategies, didacticism, where they keep a tighter control of every other variable inside the classroom while they explore the IWB.

In a progression scale, we can describe three levels of learning:

(0) no learning – IWB seen as a traditional board, or a static overhead projector;
(1) IWB as visual enhancement for teaching;
(2) IWB as intermediary to pedagogic content and;
(3) IWB as transparent tool, internalized in the planning reasoning.

After an initial stage of use, where the teachers find little novelty in the IWB, its affordances start to become clear to them, and there is a wish to explore that. The first level of real learning differentiates itself from no learning in the sense that the teachers recognize their teaching as starting to be more visual. Teachers will resort more to images, or even to short video clips, as well to slideshows at a later stage (depending on the ability to create them – with PowerPoint, for example, or on access to readymade ones). Teachers’ pedagogic reasoning starts to be re-shaped by the IWB’s at this point. Lily’s description of her lessons when she could not use her IWB properly illustrates this point quite well: “just book work, boring lessons”. Being a new teacher, her pedagogic knowledge was obviously much more rapidly affected, and therefore, she lacked a diverse base of teaching approaches foreign to IWB’s.

For Suzanne, on other hand, as for others with more teaching experience than Lily, using the IWB was described as a way of improving the visual content of their lessons. During the school year, Suzanne has been gathering images and films she can
show to her students. However, the affordance of such visually supported learning environment is pushing this experienced teacher into new activities that are only possible with the IWB. These activities are not any more an enhancement of existing lesson plans and pedagogic knowledge, but they are new approaches altogether. Such activities, that become the favourite strategies for a specific learning outcome, will substitute previous ones as mental intermediaries between classroom practices and learning outcomes. And they can only be implemented using the computing and visual capabilities of the IWB. For example, Suzanne’s present strategy to teach the solar system bases itself in a computer program that allows students to create and alter solar systems.

What I have just described is a substantial difference from using the IWB only as a visual enhancer of the lessons, and therefore, I consider it a second level of learning. Teachers in this phase are still explicit about their use of the computer and the IWB, as if it was exceptional and external to their typical practice. Progress from this second stage to a third follows the shift from explicit thought about IWB to implicit (another term would be *internalized*) use of it as a mental tool. At this point, the IWB’s become *transparent* artefacts, which is to say that the teachers do not consider this tool as separate from the activity anymore but an intrinsic part of it. I have very rarely witnessed this, which seems to indicate that the process of adoption is a lengthy one, and is far from finished in the setting of this study.

It is important to point out, at this point, that the development from one level to the other is not a sudden leap, but rather a shift in terms of preferred approach to
teaching, and it follows hand in hand with increasing familiarity with the IWB. Steve has summed up quite well in his interview:

“I use more and more, I think, as times go on (...) it has got into my lessons, and into the way I think and I use it quite often, and it’s a matter of trying to make it less teacher-led and giving more room to students if that’s what you want.” (Steve, interview)

However, it is not only a matter of time, but also of availability of promising ideas and success in trying them out. While interactive programs and computers have been available for quite some time now, the hassle of disrupting class into different settings (commonly, moving them to a computer room) has kept this shift from happening. Arlene mentioned this in her questionnaire at a point, that she started using a given program she knew for years, as that did not included taking the students out of her classroom anymore.

The idea of tensions and resolution of tensions is central to the concept of expansive learning, which Yrjo Engeström develops from activity theory. In figure 2, some of the existing tensions are shown. In abiding by rules of a larger system, the whole school, the community of practice finds itself between conflicting strands: to experiment new strategies at risk of not having successful learning or to play for sure with tried and tested techniques of teaching, in order to achieve better end of year results. Likewise, this tension exists also in the field of tensions between communities. In the schools, each teacher maintains different pedagogical ecosystems inside their classrooms. These systems interact with the larger scale systems of the department, sometimes in conflict and other times in accord. And the departmental
system interacts with the whole school ecosystem as well, which, in turn, interacts with the politically governed community of schools. Finally, the division of labour results in another group of tensions. In the particular case of adopting IWB’s, this tension revolves between the concept of teaching using readymade materials, being an accomplished teacher in carrying out other people’s pedagogic strategies versus being a creative teacher, thus investing time and effort in developing one’s own resources and strategies. More tensions can be unveiled by analyzing each teacher’s unique learning trajectory and the historicity of the whole department. However, this would be lengthy and redundant in the purpose of this dissertation.
5.3. **Comparison with existing literature on IWB’s**

The most striking conclusion of this study is that the process of adoption is slow-paced one. And, in addition, the time that adjustment takes depends on how much the teachers prefer IWB’s to traditional boards and overhead projectors. In this aspect, the literature on IWB’s finds confirmation in the case study. Furthermore, Smith et al. (2005) underline flexibility and multimedia power as the major advantages of this equipment, and that have been precisely the characteristics that are causing the teachers in Hallbran School to shift their preference towards the new technology. The interviewed teachers devalued other aspects of Smith et al.’s review, though, such as the increment in preparation time brought upon by the introduction of new technology. However, there are two possible reasons for this; one being the high level of cooperation between teachers and the preparation done at the beginning of the year, and the other being that a few teachers are still in the initial steps of the learning curve, when the IWB is an addition to existing teaching habits.

Glover and Miller (2001), in the only published study that takes a kind of case study approach to the process depicted in this thesis, were the first ones to suggest that, within a school, one could find a number of different approaches to technology. In the Hallbran School science department, just as in Glover and Miller’s school, there were *missioners, tentatives and luddites*. Moreover, it was the kind of relationship between the enthusiasts, those that would push others towards innovation, and the rest of the teachers that accelerated or slowed down the learning process of
the whole community. The same researchers have also argued that the introduction of IWB’s is a trigger to educational innovation, as they bring about an atmosphere of change. The atmosphere of change was certainly the case in this study, but whether it is an effect of the new technology being introduced or of other causes, such as the pressure of inspections, is unclear. In fact, both phenomena have probably been responsible for this.

Lastly, I would like to note that the process of learning to use the IWB in the classroom depends little in the training sessions facilitated by the suppliers of the equipment, or in any kind of stand alone sessions. The actual learning is a process more in line with the development of self-efficacy through enactive practice and vicarious practice, as defended by Peter Albion (1999).
5.4. Critique on the present study

This dissertation is the presentation of an exploratory study, and this exploratory study would be completed with further research, both deepening the current case study and by broadening its scope to other cases. In addition, as an exploratory study, it own method and choices of data instrument are at enquiry, with the purpose of ascertain their interest in future fieldwork.

In order to increase in depth, the study would profit deeply by being prolonged for a number of years. It results as one of the key findings at the end of one year of study that the learning process is far from finished, and that change continues to happen in subsequent years. This is supported as well by published long-term studies, such as the ones by Bell (2001) and by Hennessy and Deaney (2004). The main interest of such extension over time would be to focus on the individual learning process. As it stands, the connection between the proficiency in using the IWB and the internalization of it as a mind tool in pedagogic reasoning is only a draft. By following different teachers over a longer period, this cautious conclusion could be further developed or disconfirmed.

In further stages of this research, however, the emphasis should drift slightly towards individuals. As such, while field observations carried on for this research were mainly based on departmental meetings and everyday out-of-classroom dealings of teachers, those would need to change into unhurried observations of their pedagogical practices, in order to access pedagogical knowledge and reasoning. With
this purpose at aim, the use of short questionnaires and the analysis of departmental
documents would no longer be needed.

Secondly, to be able to verify some of the findings as well expand their scope,
parallel settings would need to be studied as well. This case study was set in a very
specific case, with unique features. While that was not the intention behind the choice,
and indeed opportunity was, I consider that the end result is a portrait of a successful,
although quite incomplete, process of adoption. Another case study, with a more
deliberate choice of school, would come complementary to this one. In that second
project, the setting would need to be a poorly cooperative community. Apparently, as
I have already argued, collegiality is a major engine in the adjustment and is also
enhanced by the situation. This conclusion would be best taken, however, by
comparing these findings with those of the second study.
REFERENCES

Albion, P. (1999). *Self-efficacy beliefs as an indicator of teachers’ preparedness for teaching with technology*. Association for the Advancement of Computing in Education.


(accessed in 30/06/05: http://www.shsu.edu/~lis_mah/documents/updateboardindex.htm)


British Educational Communications and Technology Agency, (2004). Using ICT to share the tools of the teaching trade. Coventry: BECTA.


APPENDIX 1: Short open-ended questionnaire

LEARNING TO USE IWB’S IN THE SCIENCE DEPARTMENT

RESEARCH QUESTIONNAIRE

NAME ___________________________________________ DATE __________

Highlights of using IWB’s in the classroom:

Problems with using IWB’s:

Discussions / sharing of ideas or resources with colleagues:

Any other comments:

THANK YOU VERY MUCH FOR YOUR COLLABORATION
APPENDIX 2: Base schedule for teacher interviews

1. Teacher’s profile
   How long have you been teaching?
   What is your specialism?
   Could you describe in short your teaching career to present?

2. Teacher’s profile, as related to IT
   How would you describe yourself in using computers in general?
   How do you feel about using IT in your teaching?
   Have you used IWB in previous years?

3. Role of teacher within the department
   Have you been teaching in this school for long?
   What is your position in the department?
   How do you perceive your role in the department / school?
   How would you describe the level of exchange of resources in this department/school?

4. IWB present use
   Do you have an IWB in your lab / classroom?
   When did you receive it?
   Have you been using it?
   In what ways have you been using it?
   When and how did you learn how to use the IWB?
Did you have any training / exploration period in the beginning of this year?
So, what do you think of it on the whole?
Do you consider the IWB to be a valuable addition to the classroom?
If so, in what ways? If not, why not?

5. Prospective use of IWB……

Do you see yourself exploiting the IWB to its full capacity?
Could you tell me what reasons keep teachers from doing so?
What sort of things do you think could be done?
Do you expect to develop your use of the IWB in the coming times?
What would you require to develop it?

Do you know any/many multimedia resources for use in the classroom (either internet or CD based)?
Are they available in your IWB/classroom?

Who do you think should find and evaluate those resources and decide about their use in the classroom?

If you had access/knowledge to/of those resources, would you consider changing your existing teaching routines?