Evaluation of GTEP Award in Tower Hamlets

Final Report

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1. EXECUTIVE SUMMARY

1.1 Project aims

GTEP have funded a three-year project in the Local Educational Authority (LEA) (now Local Authority, LA) of Tower Hamlets (2003-2006). The main goal of this project was to raise students' science attainment by teaching science through scientific enquiry (Sc1) using the collaboration of GTEP's TEEP (Teacher Effectiveness Enhancement Programme) and SEP (Science Enhancement Programme) in Tower Hamlets**.**

1.2 Research questions underpinning the evaluation

The Institute of Education, University of London was commissioned to carry out an independent evaluation of the project's evolution and its impact on the teaching and learning of science. This evaluation has been driven by the following questions:

- What evidence is there to show that the GTEP-funded project has changed teachers' pedagogy in the context of teaching secondary science in Tower Hamlets?
- In particular, what are the most significant changes taking place in classroom practice and are these more general in nature and/or specifically related to scientific enquiry?
- To what extent has this impact cascaded down from those teachers directly participating in the training programme through to the rest of the science departments?
- What kinds of evidence are available to indicate that the anticipated change in teaching is impacting on students' learning and achievement in secondary science?
- What factors could potentially contribute towards an effective and efficient intervention at a department-wide level?

1.3 Evaluation overview

In agreement with the evaluation design presented at a meeting with Gatsby and the senior science consultant for Tower Hamlets (29.9.03), the following instruments were employed to document the evolution and impact of this project in Tower Hamlets:

- Observation schedule (every year) in the first cohort of four schools to document the changes in classroom practice, including a focus on the teaching of Sc1.
- Teacher interviews (every year) with a selection of teachers from the first cohort to document how the science departments within each school are working towards its corporate goal.
- Teacher questionnaire (every year) across all science departments in all participating schools.
- Semi-structured management interviews (every year) with GTEP programme directors and key LEA officers using questions that focus on where the programme is going, highs and lows and lessons learnt.
- Trialling of TEEP's quality of lesson schedule (originally used for maths lessons).

1.4 Overall impact on teaching and learning

The evidence that has emerged, from three years of classroom observations and participant teacher interviews, indicates that the project has changed the way in which science teachers across whole departments teach. Significant changes include:

- A substantial increase in the percentage of time students are learning science in an ICT- related context. Overall, the average percentage of time students are engaging with ICT has increased from 2% to 27%.
- Increases in the percentage of time students spend engaging in practical experimental activity and focusing on particular aspects of scientific enquiry. Overall, the average percentage of time students are using scientific enquiry has increased from 16% to 24%.
- An increase in the use of collaborative group, with peers working in pairs or small groups to develop their understanding of science. Overall, the average percentage of time students are working in this mode organisation has risen from 26% to 32%.
- Greater uses of classroom talk to share understanding and promote student-student and student-teacher interaction. Overall, the average percentage of time students are spending listening to each other during either whole or small group discussion has increased from 23% to 38%.

1.5 Implications for promoting widespread educational change

Findings from the external evaluation indicate that:

- Funding helped to trigger teacher and senior school management interest, provide extra resources, in particular ICT equipment, secure time for teachers to engage in professional development, dialogue and reflection and enable the recruitment of highly skilled consultants.
- The consultants, specially recruited for the project, played a crucial role as they were able to maintain close contact with teachers and schools, in between training days, support teachers in implementing the project's goals, support departments in cascading impact and negotiate with senior management over extra training and space within the teaching timetable for planning, peer observations and departmental meetings.
- Gaining an insight into the teachers' expertise, the particular social, cultural and economic contexts within which they were teaching and the limitations of their working environments helped the project to recognise that working on an assumption that schools and teachers already had the capacity and skills required for implementing the anticipated changes was unrealistic.
- The project management's ability to recognise and respond to these actual needs of the participating schools and teachers within a more flexible framework increased and extended the project's impact. Features that were built into this project to address issues arising from the ongoing evaluation and reports from consultants include the establishment of an EAL working party to tackle language-related barriers to science teaching and learning and extra support with

behaviour management. Twilight professional development and cluster groups were created to extend access to training to all science teachers. Extra training was provided for key teachers disseminating practice within their departments and formalised internal school procedures such as the buddy-teacher system was introduced to strengthen the cascade process within schools.

- Using a cascade approach, that depends on teachers, once trained, going back to their schools to disseminate practice, will not necessarily guarantee a widespread change. Subtle pedagogical changes associated with classroom dialogue, peer collaboration and scientific enquiry may require a range of dissemination mechanisms compared with less complex changes brought about through the introduction of innovative tools such as ICT.
- Strengthening the cascade approach relies on the commitment and expertise of senior management and Heads of Departments, whose vision and power has the potential to promote and impede change. Their authority is needed to support the kinds of dissemination mechanisms, such as peer observations, joint planning and time within departmental meetings, to monitor and review changes in schemes of work and teaching, which increase the potential for an initiative to ensure impact beyond just the selected few who receive direct training.

2. OVERVIEW OF THE PROJECT

2.1 Project aims

GTEP have funded a three-year project in the Local Educational Authority (LEA) (now Local Authority, LA) of Tower Hamlets (2003-2006). The main goal of this project is to raise students' science attainment by teaching science through scientific enquiry (Sc1) using the collaboration of GTEP's TEEP (Teacher Effectiveness Enhancement Programme) and SEP (Science Enhancement Programme) in Tower Hamlets**.**

2.2 The professional development experience

The Teacher Effectiveness Enhancement Programme (TEEP) describes itself as a generic model for teaching and learning based on best practice (http://www.teep.info/). It highlights the need for teachers to engage with learning theories and for students to develop independent learning habits by combining both recent and established educational approaches under several headings. *Accelerated learning* is presented as using the principles of neuroscience, cognitive psychology and motivational theory in conjunction with teaching so that, "the science of learning and the art of teaching meet". (MacBeath, J.) *Thinking skills for learning* uses Bloom's taxonomy as a framework for planning differentiated learning objectives, questioning and activities. *Assessment for learning* looks at the purposes and practices of effective summative and formative assessment and promotes peer- and self-assessment as means of empowering students to take control of their learning. *Collaborative enquiry* offers an approach, rooted in industry, where the teacher is the mediator. Students move through an experiential cycle, working through challenges in teams, sharing the learning they have gained through this and reflecting on the overall process. *Using ICT to support/enhance learning* is illustrated throughout the programme, so that this medium is seen to underpin the learning.

Through an earlier collaboration between GTEP and Cramlington Community High School, these theoretical foundations have been translated into the TEEP learning cycle. The cycle's six stages of: 1. Prepare for Learning, 2. Agree learning outcomes, 3. Present new information through all the senses, 4. Construct, 5. Apply to demonstrate your new understanding and 6. Review and reflect on your learning, provide teachers with a practical framework to plan, design and evaluate sequences of lessons.

The Science Enhancement Programme (SEP) strives to, "raise the achievement and motivation of secondary science students, particularly through practical activities …" (http://www.sep.org.uk/index.html) Some of its specific aims include:

- building on the effective use of practical work, increasing the variety of practical work currently available
- improving the effectiveness of practical work in motivating students and developing their understanding of science;
- providing opportunities for teachers to update their knowledge and skills base;
- developing students' awareness of the nature of real scientific activity
- encouraging team work to solve scientific problems.

A core aspect of the training programme is that it develops and implements high quality practical work in science, making use of modern equipment and techniques, where appropriate, so that science teachers become more skilled and more motivated to stay in the profession.

2.3 The context

The local authority, the context within which the project was being implemented, is nationally recognised as one of the most challenging and deprived educational settings. Wealth, poverty, cultural and ethnic diversity are all prevalent in this most densely populated borough in Britain. 70% of its student population have English as an additional language with 59% of its students having Bangladeshi heritage. 57% of this student population are also entitled to free school meals (Parkin, 2006).

The 14 secondary schools in Tower Hamlets LEA were divided up into three cohorts so that, by the end of the three-year duration of the project, each school would have had the opportunity to undergo one academic year of intense professional development associated with the above programmes. Two key ‘Gatsby’ teachers from each science department within each school were identified to receive this training. The expectation was that each school would use the experience gained by these designated ‘Gatsby’ key teachers to cascade and sustain pedagogical change throughout the science department, with some follow up consultancy provision from Tower Hamlets to support science departments in initiating and maintaining this wider scale dissemination.

In the first year of the project, the two identified teachers from each of the four science departments making up cohort one attended a two-part TEEP training programme. Part one was an intensive three-day residential course where the teachers were introduced to the TEEP learning cycle and experienced the kinds of approaches promoted through this. Part two provided an opportunity later in the academic year, after teachers had had some time to try out the ideas in their classroom, for reflection and professional dialogue about emerging classroom issues and ways to address these. In addition to this, these teachers received two days of professional development from an external educational consultant with a widely respected expertise in teaching science through scientific enquiry and one day to increase their awareness and familiarity with the SEP resources. The remaining 14 of the 22 days of INSET that schools had contractually agreed to were LEA- based. Spread throughout the academic year, these remaining days gave the consultants the opportunity to work more closely with these teachers, designing and evaluating units of work structured around the TEEP cycle, demonstrating techniques in the classroom and providing constructive feedback through team-teaching and observation. The consultants also jointly ran school-based INSET with these teachers, thus supporting these teachers in disseminating ideas more widely across their departments.

3. BACKGROUND LITERATURE

3.1 Effective professional development

The provision of continuing professional development (CPD) opportunities to enable teachers to adapt and expand their repertoire of pedagogical tools has become increasingly valued by both the research and wider educational communities in the UK (EPPI, 2003, 2005). Building on this accepted recognition of the value of continuing professional development in improving and extending teachers' expertise is an exploration into the different ways in which educational change is represented in teaching and learning and the related programme content and experiences that bring these about. Fullan (2001) summarises that change might bring about revised curriculum materials and/or teaching practices and/or beliefs about curriculum and learning. Shulman (1986) highlights the role of CPD in transforming teachers' subject-specific knowledge into pedagogical content knowledge (PCK). Some of the effective characteristics of CPD programmes emerging from relevant studies include practical and real illustrations of how this theory translates into classroom which teachers actively experience (Jeanpierre, Oberhauser & Freeman, 2005), a learning professional community where teachers can talk together and grapple with the presented ideas and the implications that these may have on practice (Shulman & Shulman, 2004), ongoing support in school through coaching (Joyce and Showers, 1995) and significant opportunities for teachers to reflect on the impact that the experiences have had on their teaching and attitudes to learning (Adey, 2004).

Thus there appears to be a growing consensus within this body of literature as to what effects change in teaching and, moreover, that more work is needed to close the gap between what is being learnt from research and the reality of what is experienced by teachers engaging in professional development programmes.

The professional development aspect of the project, as outlined earlier (Section 2.2) met much of what is suggested in related literature about the key components of continuing professional development that initiate and sustain changes in teaching effectively. According to Joyce and Showers (1995), in order to accomplish potential outcomes of raised theoretical awareness, changes in perceptions of teacher and student role, development of skills and the ability to transfer these to real classroom contexts, the design of a professional development programme should include the following opportunities:

- to explore and become familiar with the theoretical rationale
- to experience demonstrations or modelling of this theory in practical settings through film, real and simulated classroom contexts
- to practice skills, initially through more supportive means such as peer teaching before graduating to full classrooms
- to develop a community of practioners through peer coaching and collaborative design of schemes of classroom work.

More specifically, Louckes-Horsley *et al*. (1998) propose seven principles of effective science teachers' professional development:

- A well-defined image of effective classroom learning and teaching
- Opportunities for teachers to build knowledge and skills
- Modelling the strategies teachers will use with students
- Building a learning community

- Supporting teachers as leaders
- Providing links to other parts of the education system
- Providing for continuous assessment and improvement.

3.2 UK Secondary science context

The potential influence that school science could have on industry and society has become increasingly recognised (Gilbert, 2006). The ‘Beyond 2000’ report (Millar & Osborne, 1998) suggested that a revised science curriculum would need to pay attention to ideas and evidence in science. In doing so, future citizens would have the necessary analytical and practical skills that would enable them to make informed decisions on science issues relating to their lives both at work and home. More recently, in response to growing concerns about the decline in interest in post-16 school science, the reduced uptake in university science and the consequential shortage in future science specialists for industry, the UK government has produced a report, ‘Science and Innovation Investment Framework 2004-2014’ (H. M. Treasury, 2004). As well as highlighting some of the causes of these real concerns (e.g. lack of skilled science teachers and uninspiring science lessons), the report also outlines a strategy to help build a scientifically literate population. Part of the strategy highlights the need to improve the quality of teaching and learning in school science.

4. EVALAUTION RESEARCH INSTRUMENTS

4.1 Research questions underpinning the evaluation

The Institute of Education, University of London was commissioned to carry out an independent evaluation of the project's evolution and its impact on the teaching and learning of science. This evaluation has been driven by the following questions:

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4.2 Evaluation overview

In agreement with the evaluation design presented at a meeting with Gatsby and the senior science consultant for Tower Hamlets (29.9.03), the following instruments were employed to document the evolution and impact of this project in Tower Hamlets:

- Observation schedule (every year) in the first cohort of four schools to document the changes in classroom practice, including a focus on the teaching of Sc1.
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- Teacher questionnaire (every year) across all science departments in all participating schools.
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The evaluation has focused most closely on cohort one (4 schools), documenting and analysing the project's impact from the start of the project in September 2003, when they embarked on their intense year of professional development, and in the two academic years that followed. By focusing more intensely on just these four schools over the duration of the project, the evaluation was able to apply the variety of research instruments to the same sample at regular intervals, capturing rich and evolving insights and observations over the three-year period. Collectively, these instruments enabled the evaluation to triangulate, through observations, interviews and questionnaires, perspectives at different levels of participation and balance this against the less subjective position of an outside observer.

4.3 Observation schedule

A copy of the observation schedule can be found in Appendix 1.

Lesson observations, collected from both the key and other teachers working in the science departments, from the four schools in cohort one were used to document changes in classroom practice. These were conducted at three points over the course of the project; round one took place between Oct 2003-Jan 2004, round two between Oct 2004-Jan 2005 and the final round of observational data were collected between Oct 2005-Jan 2006. The focus was mainly on Year 7 (11-12 year old students) science lessons. The evaluation used the science department as a unit of analysis, not individual teachers, and data were collected at roughly the same time each year in order to reduce the effect of the particular topic and other variables.

The four science departments varied in size from one containing 7 science teachers to one containing 15. Roughly, a total of 38 science teachers could be observed across the departments. Round one observational data captured 61% of these teachers with 23 teachers being observed across the 29 lesson observations made. Round two observational data represented 74% of the 38 teachers with 29 teachers being observed during the 29 lesson observations made. In the final round of observations, 27 teachers were observed representing 71% of science teachers available in cohort 1.

The same observational schedule, developed earlier by other higher education establishments and used in parallel projects, was used throughout to capture changes in the classroom. In essence, based on a modified version of the Flanders (1970) observation scale, this schedule collected observations of student activity every 5 minutes and classified these into a number of predetermined categories. These categories generated the mean percentage of time students spent working in three modes of organisation (whole class, pair/group work, individual), and how much time, on average, students were engaged in a variety of specified classroom activities during these modes of organisation. Examples of student activity include ‘listening to the teacher’, listening to each other’, ‘being managed’, ‘using ICT’ and ‘experimenting’. When students were observed to be experimenting, scientific enquiry was explored in detail using descriptors from the science National Curriculum guidelines for key stage three as additional categories. At the point of observation, for a given mode of organisation, more than one category of student activity could be recorded. For example, students might be observed to be working in small groups, listening to each other and experimenting, with a specific focus on obtaining evidence. Analysis of these schedules helped to document how much time students are engaged in a range of activities and whether these occur in a whole class, group or individual context.

At the end of each observation, the results of the schedule were shared with the class teacher and a copy left if requested. The science consultants funded by the project to work in the local authority, the SEP consultant and the evaluation team used the schedules for some joint observations. These have helped to develop a common understanding of the schedules and hence increase inter-observer reliability.

4.4 Interviews

The complete set of questions posed during the teacher interview can be found in Appendix 2.

Four rounds of teacher interviews were conducted (January 2004, June 2004, March 2005, February 2006). The main aim of the semi-structured interviews were to speak to a small sample (13 out of the possible 38) of teachers across the four schools in the first cohort who would collectively represent the range of professional experience, views and attitudes shared by secondary science teachers in the LEA. Thus, the sample, which remained mostly unchanged over the three years, included all the key teachers, Heads of Departments (HoDs), newly qualified teachers, recently appointed staff and teachers who have worked for over five years in the department. In the last round of interviews in February 2006, 7 of the original 13 teachers were interviewed. This included 5 out of the 8 key teachers who started their professional development in September 2003 and were still teaching at their schools. The evaluation also tried to capture a balance of perspectives from those enthused by the project through to those who were more resistant and slightly cynical of the project's intentions. In all cases, the teachers spoke freely and were extremely accommodating. All interviews conducted took place at the schools. Most of the interviews took 20-30 minutes and were recorded straight onto a laptop.

The questions were designed to obtain a participant teacher understanding of and response to the underlying aims of the project as well as a deeper insight into the project's impact on teaching and students' learning from their perspective. Questions included:

- Have you noticed any changes in how you teach science? Tell me what kinds of things do you think you are doing differently?
- What do you think have been the main challenges facing you and your department in making this project work?
- How are the children responding? What kinds of effects on their learning have you noticed?

Analysis of each round of interview data focused on the responses that the participants gave for certain key areas, in particular what kinds of challenges they felt they faced and what kinds of impact they perceived the project was having on teaching and learning. Through open-coding, identified key words/phrases were used to help generate a set of themes into which specific aspects of the responses could be allocated and counted.

Four rounds of management interviews were conducted (March 2004, July 2004, March 2005 and March/April 2006). Eight key agents representing both the Gatsby Charitable Foundation and the LEA were asked questions to obtain their perspectives and insights on the development of the project and its challenges, successes and impact. Each of these semi-structured interviews took about an hour and was recorded straight onto a laptop. By the last round in 2006, 6 out of original 8 interviewees (4 TH, 4 Gatsby), were still available for interviews with one additional replacement. Questions included:

- What part do you play in this project? Do you feel your role has changed since?
- Looking back since the start (or since the last interview), how, in your opinion, has the project evolved?
- What do you envision/hope the teachers and the students will gain from project?
- What changes do you think need to be made to help the project work successfully in schools?

The complete management interview schedule can be found in Appendix 3.

4.5 Teacher questionnaire

The teacher questionnaire can be found in Appendix 4.

A short teacher questionnaire was distributed out to all the science teachers working in the participating schools as they embarked on the professional development programme. Teachers were asked to share their professional biographical details and answer three open-ended questions:
1) Please write down below what you think the project is aiming to achieve; put down what you think are the project goals.
2) Now write down what you think are the principal problems facing your students in learning science.
3) Please write below how you think the project may help your students learn science more effectively.

4.6 Acknowledgement

Throughout the three-year evaluation, the data collection process ran smoothly largely due to support from the consultants for Tower Hamlets LEA and the good will of the teachers in the schools. Furthermore, GTEP directors and key LEA officers were highly co-operative in arranging and responding to the interviews.

5. IMPACT ON TEACHING AND LEARNING

5.1 Year 1: A pre-project overview

Between October 2003 and January 2004, 29 Year 7 science lessons were observed across all four science departments that made up cohort 1. Of the possible 38 teachers that could be observed teaching within these departments, 23 (61%) were represented in this data set. This set included observations of all 8 key teachers, 2 identified from each department that would directly receive professional development starting in October 2003 as well other teachers with a range of teaching experience (1-34 years) and roles within the department. Figure 5.1 gives an overall summary for how much time students were engaged, on average, in different activities during a science lesson. Table 5.1 indicates how much time students were spending, during these same lessons, learning as a whole class, in small groups (including in pairs) and individually. This overview provides some insight into what science teaching was like in these schools before the project's pedagogical seeds had been sowed.

Figure 5.1
Average percentage of time students are engaged in different activities during a science lesson across all four science departments, October 2003

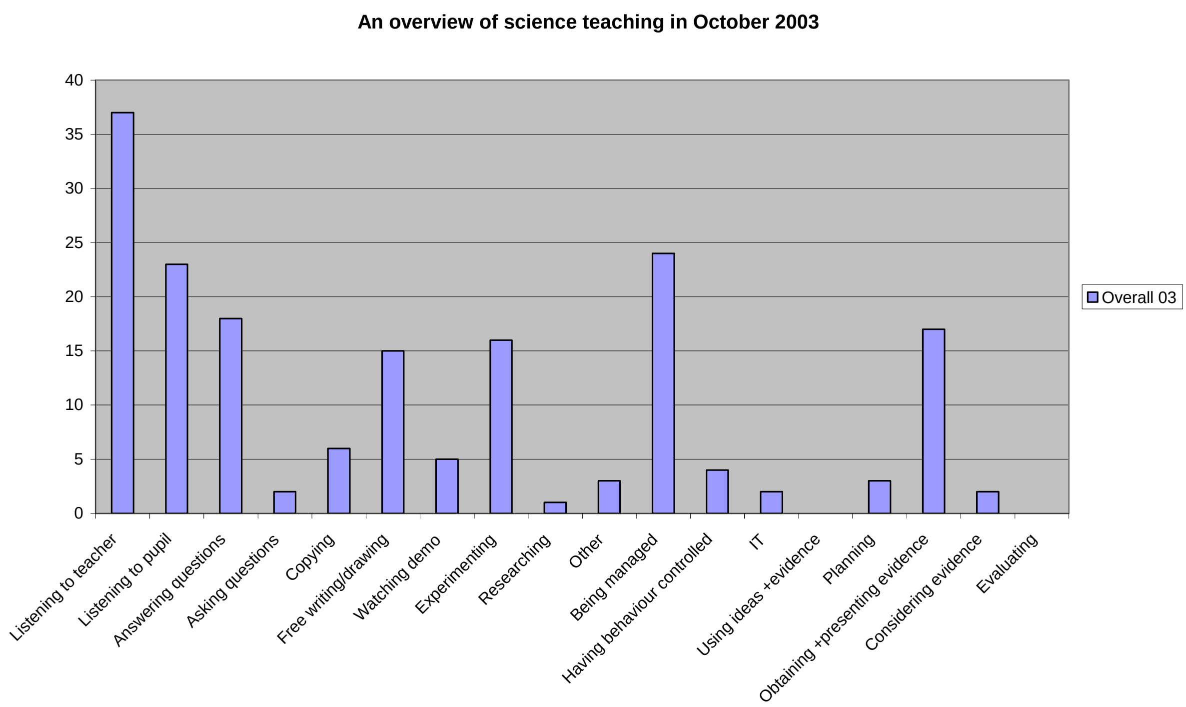


Table 5.1
Average percentage of time students are engaged in different modes of organisation across all four science departments, October 2003

Mode of Organisation	Overall Oct 2003

Whole Class	59
Small Group	26
Individual	15

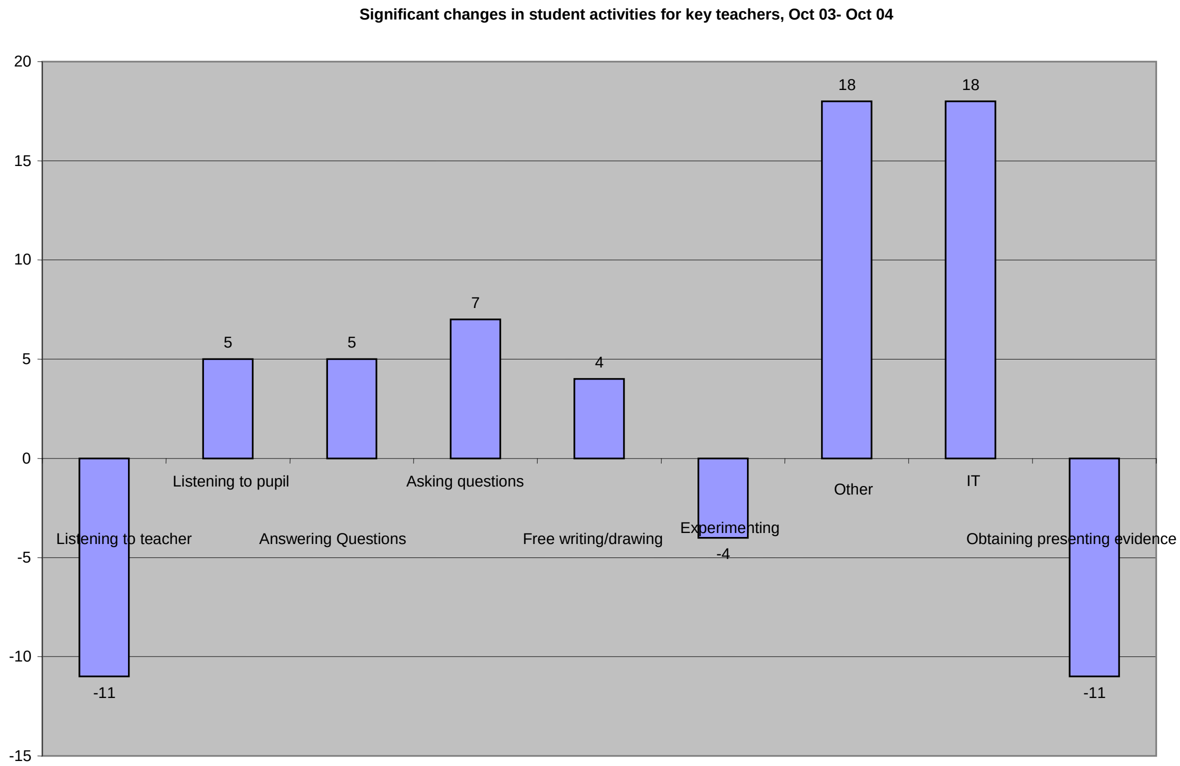
According to the above data, in October 2003, year 7 students from the first cohort of four schools tended to spend the majority of their time learning school science in whole class contexts (mean of 59% of a science session). Sitting along laboratory workbenches, these students would mainly develop scientific skills and concepts through listening to the teacher talk at the front (listening to teacher, 37%). The teacher would introduce the science topic and check for understanding by asking questions and listening to individual students' answers (answering questions, 18%), moving from student to student (listening to students, 23%) until the response matched what the teacher was looking for. A lot of the classroom talk revolved around management or administration (being managed, 24%). The teacher would spend time carefully explaining instructions to tasks – what page of the textbook to turn to, what sections to read, what questions to answer – before asking students to complete these tasks in their books, working individually (mode of organisation – individual,15%). Students were having some opportunities to work as a group. mainly in fours or fives (mode of organisation – group, 26%), and this tended to occur when they were being asked to carry out a science experiment (experimenting, 16%). Again, the students would listen to the teacher talk through how to carry out the experiment, step by step, highlighting health and safety aspects along the way. Doing a science experiment typically entailed following these instructions exactly so that the measurements obtained (obtaining and recording evidence,17%) could be recorded into a table and then, time permitting or as an extension, presented as a graph. With so much classroom time being used to instruct and explain, lessons tended to end abruptly and in mid-flow. Apparatus needed to be cleared away, books collected and students ready to move to another classroom/subject. Informal comments from these teachers after the lesson highlighted their dissatisfaction; learning intentions were half met, resulting in needing to carry work over into the following week. There never seemed to be enough time to draw up conclusions or evaluate the learning.

According to the questionnaire, collected from 32 out of the possible 38 teachers working in these science departments in this first year, these teachers felt constrained by the limitations and barriers associated with their school environment, working systems operating within this and the students they were working with. The questionnaire data suggest that these teachers associated some of the biggest challenges of teaching and learning science in their schools with language issues (44%), student perception that school science is irrelevant to everyday life (22%), difficulties in the understanding of science concepts by students (22%), and a lack of student motivation and enthusiasm for learning (19%). Language was a particular concern. In all four schools, English was not the first language for the majority of the students. Being able to communicate and learn science through text was seen as a necessary and important vehicle, especially for those teachers reliant on the use of textbooks.

5.2 Year 2: Impact on the 'key teachers'

By October 2004, all the key teachers had completed the first stage (internship) of training. Enthusiasm and commitment to the project was strong amongst this group. Figure 5.2 has extracted the observation data representing just these key teachers in cohort 1 one year on (October 2004), and compared it against their observed lessons from the first round of observations in October 2003. Changes in the mean percentages of time the students are engaged in each category, one year on, were analysed further. An arbitrary cut off point of ±4% was identified in order to focus better on the more salient features coming through.

Figure 5.2
Significant (4%+) changes in student activity during a science lesson for key teachers October 2003-October 2004



For the key teachers, there were some noticeable changes in the way they taught science lessons to Year 7 students, one year into the project. Significant trends, emerging from this, support many of the reflections these teachers made in their interviews about ways in which they perceived their teaching had changed. There were major developments in the variety of tools and media these teachers were employing to engage and enthuse students in science classrooms. The mean average percentage of time that students were engaged in IT-related activities had increased by 18%. Field notes made during these observations suggest that there was a greater teacher use of images, music and PowerPoint presentations to introduce lessons and engage children in whole class or small group activities. However, most of the notes made were in relation to teacher use of IT to lead lessons. Very little was observed of students independently using IT in small groups or pairs.

In their interviews, these 'key teachers' talked about these new tools that they were using in their classrooms, in particular, PowerPoints featuring exciting images from the real world to engage the students:

"[I] Use multi-media to set the scene. I used a slide show in Year 7 introducing the topic of forces and motion – unit on speed and velocity. Used a programme called fifth gear – video clip of who was fastest (world's fastest car against world's fastest plane). My brother is an ICT expert – took the clip, muted the sound, and wrote these as subtitles (speeds, facts and figures all related to the topic) to the music – 'I like to move it'. Paused it at the point of asking who will be the fastest and this lead on nicely to speed as the learning objective. Put speed into perspective. It settled them, hooked them in. Takes a lot of time … having video streaming from PowerPoint." (Key teacher, June 04)

When the 'Other' category was observed, additional field notes were made to describe what was taking place. During these points of observation, students were engaged in what could be considered less traditional science teaching activities. These included groups of students modelling particle behaviour in solids, liquids and gases, a visual presentation of how acids and alkalis react to form salts and smelling lemons as a way into developing language to describe acids. Thus, the 18% increase in the percentage of time students were engaged in 'other' activities could be attributed to a growing use of more creative teaching and learning methods during science lessons using relevant and accessible contexts. 'Other', however, did also include situations when children were reading from textbooks – but this was not common.

The theoretical approaches and educational initiatives that had been blended to create the TEEP model (i.e. learning styles, assessment for learning, accelerated learning) would lace the second round of teacher interviews:

"I can plan for a wider range of activities to support pupils' learning. I am planning to give choice of learning styles to the pupils. Not in every lessons, but some. So, for a rates of reaction [I have a] modelling zone, video zone, text activity-physical, visual and linguistic. So I am giving them a choice and not just teaching them my favourite learning style." (Key teacher, June 04)

The lesson observations also indicate a shift in the balance of ownership of science lessons between the teacher and the students. There was a noticeable, 11%, decrease in how much time students spent listening to the teacher as a whole class. During whole class phases, there seemed to be a shift towards more student-led discussions. This interpretation is further supported with smaller percentage increases in the time students spent listening to each other (+5%), answering (+5%) and now asking (+7%) questions. Students were being given more control of related reading and writing tasks (+4% free writing/drawing), working collaboratively in teams of 4-6, researching and making posters to present their conceptual understanding back to their class.

During the second round of interviews with key teachers, their reflections on their practice hint at how the project's pedagogical model was starting to penetrate their attitudes towards teaching and the role that they and the student/learner play in this process:

"I'm less content-orientated; less neurotically worried about getting through the content. Because I've seen that through the Sc1 emphasis, content is also delivered effectively and pupils find that this approach is more interesting."
(Key teacher, June 04)

"I have thrown away the instruction sheets and encouraged them to make choices and solve problems by themselves. Gatsby has affected this." (Key teacher, June 04)

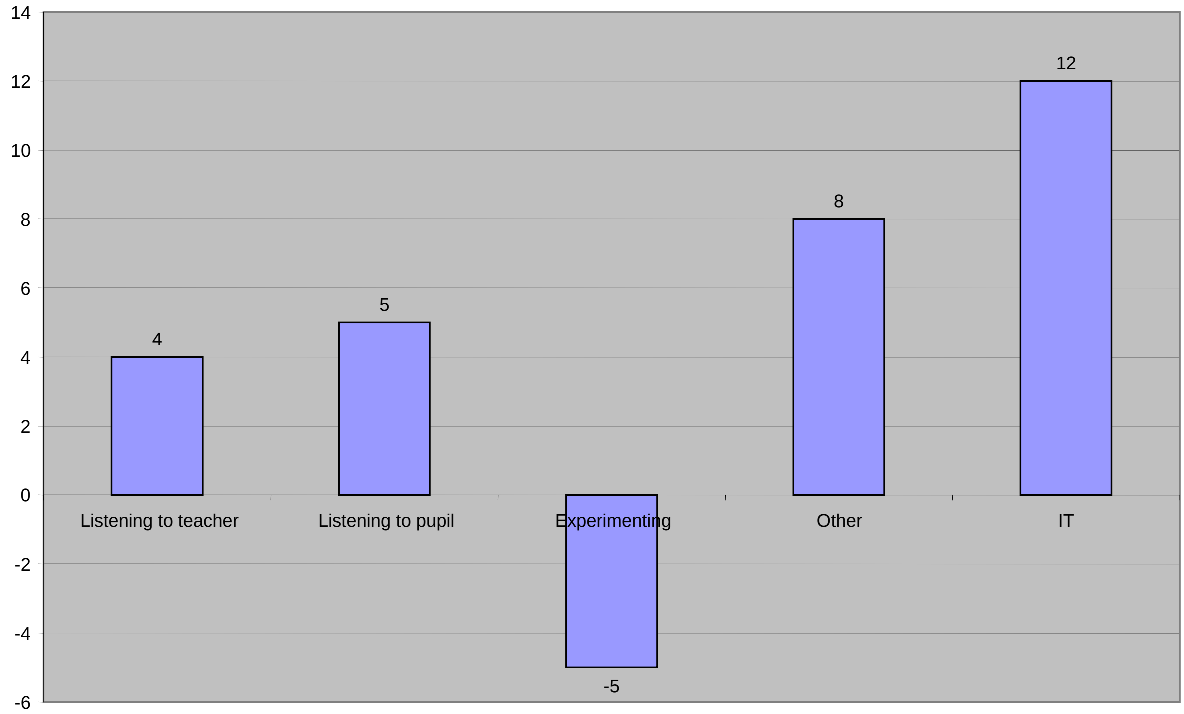
Yet, amidst all this change, the project could be seen as also having a detrimental effect on the very aspect of science teaching that it had set out to improve: scientific enquiry. There was a decrease, 4%, in the percentage of classroom time that students spent on science investigations. In the time that they did spend involved in investigations, less time (-11%) was being spent obtaining and recording data. This unexpected and, perhaps, disappointing downward trend will be explored later on in this report.

5.3 Year 2: Impact on the non-key teachers

A key question driving the evaluation for this project was: To what extent has this impact cascaded down from those teachers directly participating in the training programme through to the rest of the science departments? Figure 5.3 collects all the observation data gathered from the other, non-key, teachers working in the science departments in the first cohort of schools, and identifies any of the categories that showed a significant (± 4%) change from Oct 2003- Oct 2004.

Figure 5.3
Significant (4%+) changes in student activity during a science lesson for non-key teachers October 2003-October 2004

Significant changes in student activities for non-key teachers Oct 03-Oct 04



Although there were some similar, albeit less pronounced, trends (+ 12% IT, +8% Other, -5% Experimenting, +5% Listening to student) running parallel with the observation data for just the key teachers, other significant developments were absent from the overall picture of pedagogical change. What could be considered as the more complex and subtle pedagogical shifts, involved with classroom dynamics and student ownership of the learning, had not been transferred across whole science departments at this stage. In the management interviews, the LEA consultants quickly realised, from their school visits, that many of these science teachers needed professional development support with classroom and behaviour management: “Last year we found that behaviour was a stumbling block … had conversations with our behaviour consultant” (Management, March 2004).

Although not part of the project’s original plan, it became clear to those managing the project that this needed to be addressed first before attending to the project’s more innovative and subject-specific pedagogical aims. Perhaps this relates to the shifts in controlling behaviour (-4%) and classroom management (+5%).

5.4 Challenges of cascading change

In January 2004, key teachers were already starting to voice their concerns as to whether their role, in these early stages of their own professional development, in this cascade process had been fully thought out:

"The only downside is that the school itself is not given funding to give the key teachers extra time to trickle down and cascade the work. My concern is that the only people who will be effective in delivering this will be just the two Gatsby [key] teachers. And how the rest of the science department respond will depend more on their enthusiasm and motivation to improve their practice … Really finding it hard to cascade within the current structure of the school because there are lots of other things going on [INSET etc]. Think the most important thing we need is peer observation." (Key teacher, Jan 04)

The extent to which schools were genuinely committed to the project and related responsibilities which included providing time and other support to key teachers in disseminating ideas throughout the department became critical to the success of the cascade model. In their interviews, as illustrated above, key teachers expressed their frustrations in trying to fulfil their roles against a working backdrop of sporadic departmental meetings already taken up with other high priority agendas and a lack of non-contact time in the teaching timetable in order to facilitate peer observations and joint developing and planning of teaching units.

During this phase of interviews, the key teachers were starting to consider the amount of teacher expertise and confidence that some of the pedagogical shifts, associated with student ownership and interaction, necessitated for their wider departmental community:

"Whole idea of group work skills – explicitly teaching them how to work as a group. You are the leader … TEEP has made me conscious of what is good. [I have] made lessons more pupil-centred. So easy to stand up and talk but even easier if children talk, stand and move around. I probably talk less. Teachers need to take more risks in getting pupils to talk. Group work. Some teachers are afraid to do this. About managing talk." (Key teacher, Jan 04)

"Doing that quantum leap from 'what do we do now Sir?' to sitting and thinking about an investigation independently will be a big task." (Key teacher, Jan 04)

One interpretation, triangulating these teacher perspectives with the observed practice, could be that different dissemination mechanisms are required to bring about different kinds of pedagogical impact. PowerPoint presentations, other tools and small-step strategies that embrace a variety of learning styles might be more transferable; easily exchanged over informal conversations at breaks in the school day. Readdressing the dynamics of the classroom, organising the learning so that the student is more empowered and engaged through greater use of collaborative group work and less teacher led-discussions and teaching science through scientific enquiry requires more than a 10 minute chat over coffee. Perhaps these kinds of deeper pedagogical changes take longer and need to be facilitated through peer observations, joint planning and departmental dialogue; the very same vehicles for dissemination that key teachers felt lacking in their schools at this stage.

5.5 Year 3

By October 2005, the consultants were treating the project's initial plans more flexibly and using the refined plans to respond to the needs of their key teachers and the departments they were working in. More support with classroom and behaviour management was incorporated within the professional development programme. The cascade model became more strategic and supportive. The two-part TEEP training programme was broken down into a series of twilight sessions and any teacher was invited to attend, thus extending access to the more exclusive aspects of the professional development programme out to all science teachers. Key teachers were sent on extra training in the following academic year with a focus on coaching and how to disseminate practice. The consultants worked alongside the departments to formalise a buddy-teacher system to facilitate peer observations and joint planning and run departmental INSET. The consultants shifted their agenda from supporting teachers to supporting coaches.

5.6 Impact on key and non-key teachers two years on

A third and final round of 27 year 7 lesson observations were collected, representing 71% (27 out of the possible 38) of science teachers working in cohort 1. Two years on from the start of the project, 5 of the original 8 key teachers were still teaching in their science departments. Figure 5.4 compares any significant (± 4%) changes in student activity from Oct 2003-Oct 2005 for the key teacher group with other, non-key science teachers working in their departments. Figure 5.5 shows significant changes in student activity from Oct 2003-Oct 2005 for all science teachers working in schools in cohort. Table 5.2 compares modes of organisation for all these groups.

Figure 5.4
Comparison of significant changes in student activities between key and non-key teachers October 2003-October 2005

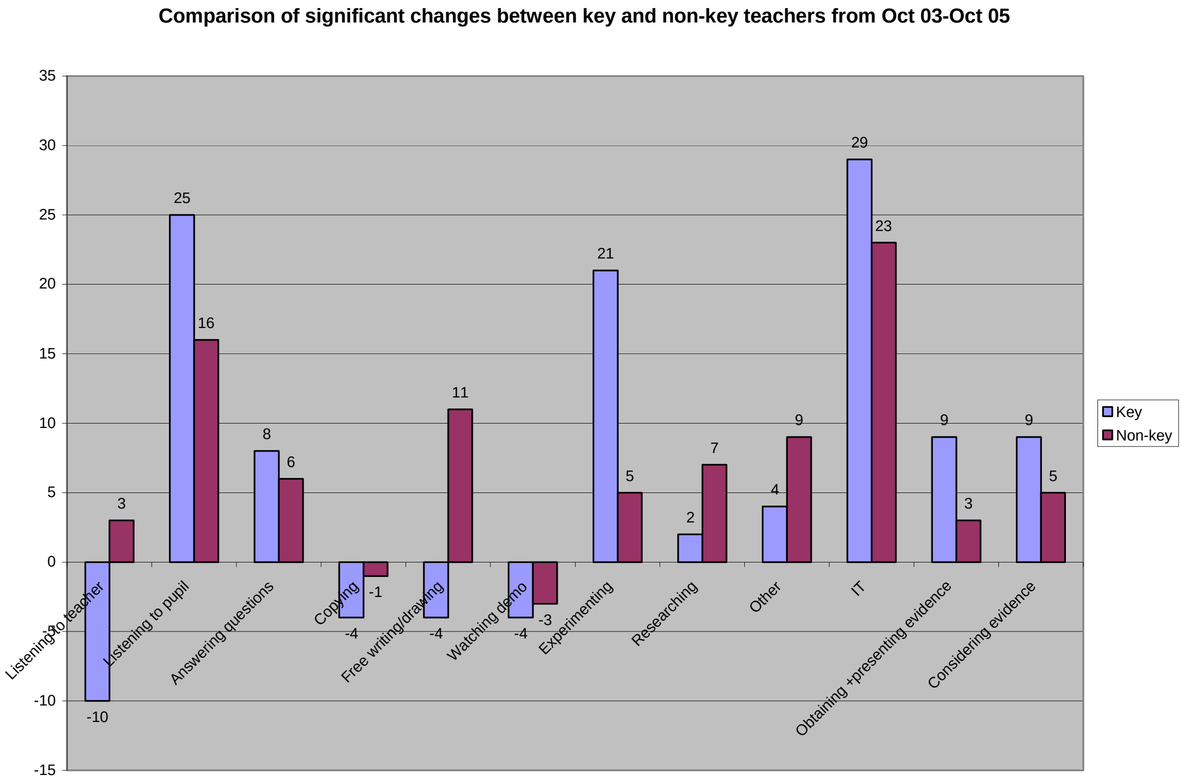


Figure 5.5
Significant changes for all teachers across the four science departments in cohort 1
October 2003-October 2005

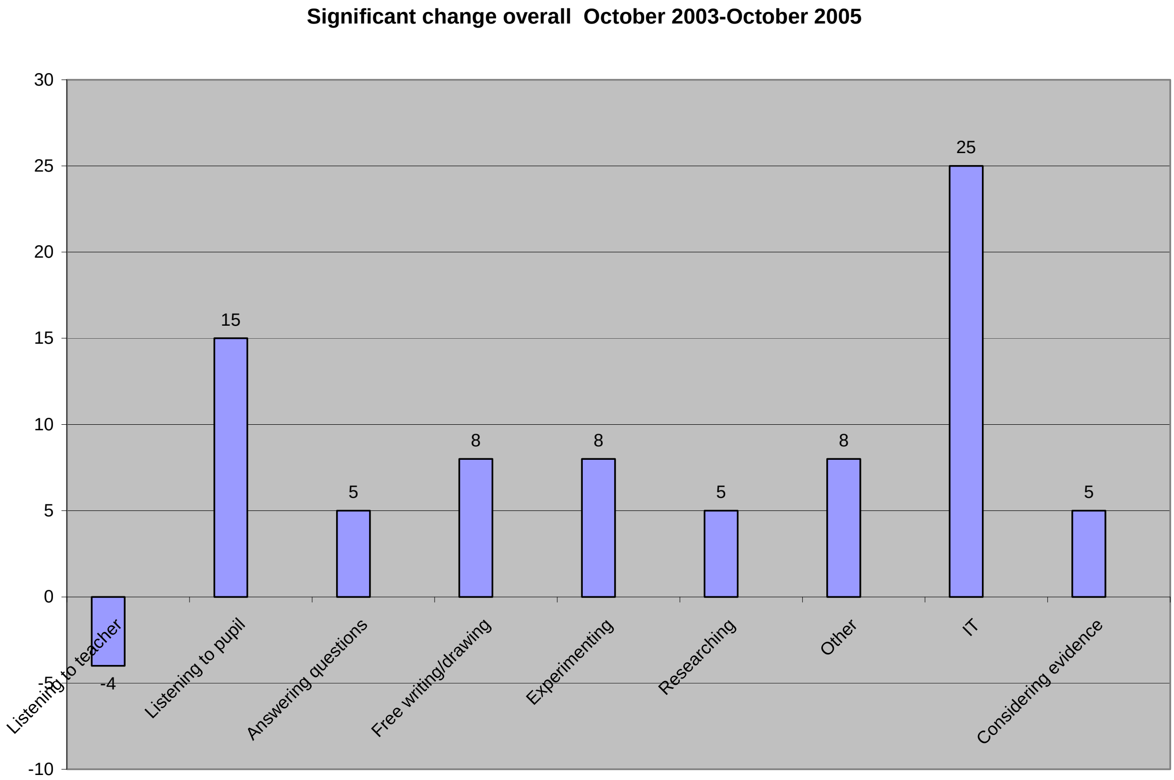


Table 5.2
Comparison of modes of organisation for key and non-key teachers
October 2003 and October 2005

Mode of Organisation	Key Oct 03	Key Oct 05	Non-key 03	Non-key 05	Overall 03	Overall 05
Whole Class	60	57	58	60	59	60
Small Group	27	37	24	28	26	32
Individual	13	6	18	12	15	8

Impact on ICT

Two years on, since its inception in 2003, the project has increased the amount of time ICT is used by all teachers across the four science departments, to engage the learner during science lessons from 2% to 27% overall (2% to 25% for non-key teachers, 2% to 31% for the key teachers). In the final round of teacher interviews in February 2006, ICT was raised by teachers in 6 out of the 13 interviews. In 4 cases, teachers mentioned incorporating more ICT into their science lessons as one of the ways in which they felt the project had impacted on their practice. But alongside this emerges a heightened awareness of access and availability. In two interviews, the teachers felt that the project could have even greater potential if there was a central bank of resources, PowerPoints and lesson plans stored on the main server so that any teacher could access these in their classroom. Another interviewee noted that in their school, central access would only benefit half of the department who have interactive whiteboards in their rooms. This teacher felt that this inequality of access was restraining a widespread dissemination of the project across the department.

Impact on scientific enquiry

After two years, the project appears to have made a strong pedagogical impact on how much time all teachers dedicate to developing aspects of scientific enquiry through experimental activity. On average, during a science lesson the amount of time students are engaged in this has increased from 16% to 24% overall (14% to 19% for non-key, 17% to 38% for the key teachers). A closer inspection of gains for the individual strands that make up scientific enquiry, as laid out by the National Curriculum for Science, locates this impact. During these increased percentages of experimental activity, students continue to obtain and present evidence, increasing significantly for the key teachers from 22% to 31% over the two years. For both groups, there is also a notable rise in the time that they spending considering this evidence, increasing from 2% to 7% overall (2% to 7% for non-key, 1% to 10% for the key teachers). In the final round of teacher interviews, better use of and incorporation of Sc1 in their teaching was mentioned in 5 interviews, as the following extract from a key teacher interview in February 2006 illustrates:

“Think I am much better at teaching Sc1. Before, investigation was a whole task. Now I focus on the skills. If I want them to plot a graph, say for a respiration experiment, but if I haven’t taught them that skill then I have to teach it in the lesson. Now I teach right from Yr. 7, a progression of these skills separately. Taking one skill at a time, say planning – design a question, what you will change, measure.” (Key teacher, Feb 06)

Impact on modes of organisation

While the mode through which learning is being facilitated continues to be dominated by whole class teaching (around 60% of a lesson), there appears to be a shift away from individual work and towards greater use of peer collaboration. Over the two years, the percentage of time students are working in small groups (including pairs) has increased from 26% to 32% overall (24% to 28% for non-key, 27% to 37% for the key teachers). During this period, the percentage of time students are working individually has decreased from 15% to 8% (18% to 12% for non-key, 13% to 6% for the key teachers). In February 2006, 9 of the 13 interviewed teachers associated the project with a shift towards more small group-based activities in science lessons, now describing how they have developed strategies to support student participation and co-operation in groups through allocating roles, providing guidelines and using peer- and self-assessment to evaluate group performance.

Impact on classroom talk

The amount of time students are spending listening to each other, through a whole class discussion, paired talk or group work, has increased from 23% to 38% overall (18% to 34% for non-key teachers, 28% to 53% for the key teachers). The amount of time students are answering questions has increased from 18% to 23% overall (16% to 22% for non-key teachers, 20% to 28% for the key teachers). The amount of time students are spending during a science lesson listening to the teacher has decreased from 37% to 33% overall (although this change is only substantial for the key teachers with a decrease from 43% to 33%, while non-key teachers show an increase from 30% to 33%). A couple of the key teachers have become more aware of how they 'talk less' and that, perhaps in doing so, one perceived impact on learning is that the students are communicating their ideas in science more, elaborating on their thinking and growing in confidence.

Impact on student ownership

Just over half of the teacher interview sample in February 2006 (7 out of 13) felt that good teaching and learning strives to encourage students to take responsibility for their learning. Notions of the student being an 'independent, lifelong learner', able to talk and think about their learning were either mentioned as one of the aims or a learning outcome of the project by these 7 teachers. As in early interim reports, setting up a classroom environment that promotes this was felt by the interviewees to require a transfer of power in their practice.

Impact on enjoyment

When responding more personally about how they feel about the project and the impact they think it is having on their students, some expression of enjoyment featured in 11 of the 13 interviews conducted in February 2006. Some teachers felt that the project has essentially helped to put 'enjoyment back into science'. In other places, teachers described how the project has helped them to develop teaching strategies that make science more 'interesting'. As a result, one perceived impact on students is that they 'look forward' to the lessons and seem 'more confident'. This in turn has raised teacher enjoyment and confidence although, as one teacher reflected, "When I do TEEP lessons and they work well, I have more fun myself. But I can't find the time and energy to do it for every single class, for every single lesson."

Collectively, these data may indicate that, after two years, the professional development gap between those who have received direct (key teachers) and indirect (rest of the science department) training has been narrowed, but not closed, since some of the common trends (e.g. listening to students, experimenting) are still more pronounced for key teachers.

5.7 Further data

Data collected from teacher questionnaires can be found in Appendix 5. Appendix 5 includes teacher profiles for each of the four science departments in cohort 1 and an analysis of responses to the open questions at various stages of data collection. The percentages of student activity year on year, overall, for key and non-key teachers and for each of the four science departments can be found in Appendix 6. Observation figures showing student activity across the three years for each department can be found in Appendix 7.

6. ANALYSIS OF KS3 SCIENCE TESTS

Originally it was intended to identify an available published test to track and measure the impact of the project on students' understanding and ability in science at Year 7. Agreeing on a test design that included more complex aspects of scientific enquiry whilst remaining sensitive to existing pressures on schools, teachers and students proved to be problematic. Although the project initially focused on Year 7, participating teachers and the LEA quickly and instinctively transferred the key pedagogic principles throughout KS3. Therefore, one way of exploring impact on learning is to look at the science results of the government test used at the end of KS3 for any possible indication of impact on student achievement. Of the 16 listed secondary schools in Tower Hamlets, 14 have published their KS3 data from 2002-2006. Hence, the percentage for LBTH represents these 14 schools. Table 6.1 presents the percentage of students scoring level 5 or higher in science at KS3, nationally, across the whole LEA and for the 1st Gatsby cohort of four schools. Table 6.2 gives a breakdown of results for each of the four science departments that make up the 1st Gatsby cohort. At the time of writing this report, the results for 2006 are provisional.

Table 6.1
KS3 Percentage of level 5+ science results 2003-2005, National, Cohort 1 and LBTH

	Percentage of students gaining L5 or higher 2003	Percentage of students gaining L5 or higher 2004	Percentage of students gaining L5 or higher 2005	Percentage of students gaining L5 or higher 2006
National	68%	66%	70%	72%
LBTH	46%	49%	52%	56%
1st Gatsby cohort	46%	54%	57%	63%

Table 6.2
KS3 Percentage of level 5+ science results 2003-2005, cohort 1

	Percentage of students gaining L5+ 2003	Percentage of students gaining L5+ 2004	Percentage of students gaining L5+ 2005	Percentage of students gaining L5+ 2006
Science Dept. 1	47%	57%	64%	72%
Science Dept. 2	45%	44%	63%	54%
Science Dept. 3	40%	51%	46%	60%
Science Dept. 4	52%	65%	56%	66%

The data suggest that the London Borough of Tower Hamlets has continued to make gains in science at KS3 from 2003-2006. This trend dates back further, before the start of the project, with gains of +3% from 2002-2003 and +2% from 2001-2002 for the 14 school. For LBTH, the percentage of students scoring level 5 and higher has increased from 46% in May 2003 (22% below the national average) to 56% in May 2005 (16% below the national average).

Since making a considerable gain of 8% in the first year of the project, the first Gatsby cohort has continued to improve steadily at 3% between 2004 and 2005, and at 6% between 2005 and 2006. For this first cohort of schools, who have had the full benefits of the three year project, the percentage of students scoring level 5 and higher in their KS3 science tests has increased substantially from 46% in 2003 (22% below the national average) to 63% in 2006 (9% below the national average).

Attributing the significant rise for cohort 1 in student performance in KS3 science tests solely to the impact of the Gatsby project would be over simplistic. The varied progress as illustrated in Table 6.2, over the duration of the project, for each of the four departments hints at the complex interplay of factors that can potentially promote or impede educational change. This variation is echoed in the departmental analysis of change in student activities during year 7 science lessons as presented in Appendix 7. Key factors associated with the learning environment, school management and stability of staff will be considered in relation to the departments in the concluding thoughts.

7. EVOLUTION OF PROJECT MANAGEMENT

Through an analysis of the management interviews several underlying features that have influenced the evolution of the project and its consequential impact on teaching and learning have emerged. The five stages of group development, forming, storming, norming, performing and adjourning (Tuckman & Jensen, 1977), commonly used in the business sector, provide a sequence and a framework within which these features can be located and examined.

7.1 Forming

The initial forming stage is a time for the group to create a joint identity and begin to establish trusting relationships. Responsibilities and goals are defined. Individual members may hold high positive expectations but also feel anxious about their roles.

At the outset, the project involved a number of unfamiliar partnerships. The external organisation, the financial provider, was introducing a unique collaboration of two programmes and their respective two directors. The local authority, with no prior working connection with their external benefactors, had already secured some of the newly acquired funds to recruit two consultants to work alongside their more established consultant. New to their roles as advisors, these two experienced teachers were both excited and nervous at the anticipated prospect of mediating and negotiating with schools, head teachers and teachers with whom they had little to no previous relationship. The time framework within which the proposal was drawn up and accepted, management teams at both ends were established and preparations put in place to begin work with schools was tight, about 3 months. This limited ‘forming’ space threw up some early challenges.

Over half of the key agents were not involved in the early stages of the proposal and consequent project design. This restricted opportunity to influence and, furthermore, have greater ownership of the project led to early frustration.

“No strategic thinking about this. Had we been involved in the skeletal model then we could have had some input on this.” (Management, 2004)

Reaching some agreement on a vision for the project’s aims and principles was hampered by initial communications between the external agency and the local authority during the drafting of the proposal:

“I think there have been teething problems. Probably stemmed from the lack of clarity from the foundation, which led to a vague proposal from me. Which is unfortunate because that is what we are being assessed against.” (March 2004)

This lack of shared ownership and clarity became the root of what was to permeate much of the consequential storming phase, a phase that the group quickly entered due to the confined time they had to form and build trust.

7.2 Storming

The inevitable and vital storming phase is characterised by conflict, anger and frustration as members test each other, air their disagreements and question the project's intentions.

One of the main sources of misunderstanding within the group was how the two programmes were to complement each other and work together to raise achievement in science in the local authority. Differences in expectations and goals of the two programmes did not seem to be communicated within the group and, when these were not met, this led to a sense of early disappointment:

"Thought SEP was going to work with generic TEEP model and input in the science but hasn't happened" (Management, July 2004)

"I don't think I am entirely clear of the SEP involvement – is it resources or Sc1?" (Management, July 2004)

"Need greater clarity of what SEP is. Thought at this point there would be lesson plans combining SEP and TEEP." (Management, July 2004)

Perhaps this, compounded with the dynamics between the strong and passionate personalities leading the project and the pressures involved in negotiating training days out of school, could all have contributed to the 'competitive element' between the two programmes that some of the management interviews allude to:

"It feels to me that there is a tension between TEEP and SEP. TEEP is exciting and innovative ... Teachers and consultants have been more turned by TEEP … No one has disagreed that those resources have been useful. Trying to bring those two projects much more in line with each other … Feels sometimes that we are at the end of competing demands." (Management, July 2004)

The hasty formation of the group triggered early confusion and perhaps later conflict about the different roles, responsibilities and ultimate goals for the project:

"Ground rules were not set at the beginning. With three directors, this can lead to misunderstandings, lack of direction." (Management, July 2004)

"Issues about power, preventing one of the consultants from going on level 2 training. But I put my foot down. Not something I would have expected to deal with. Have we got the same agenda? " (Management, July 2004)

"… Suddenly announcing that [TEEP] needs to give the consultants more training. Who employs these people [consultants]? I think it is Tower Hamlets … What is this project about? It is about Tower Hamlets not Gatsby." (Management, July 2004)

During the first year of the project, further role changes in the way of re-allocating responsibility to one existing member and the departure of the local authority senior consultant both heightened and eased existing turmoil as the remaining group members tried to readjust:

“ … In some ways that has eased the situation and in some ways it hasn’t. Has helped in terms of personalities - things are calmer. But I am not sure what role of SEP is.” (Management, July 2004)

“Without [the consultant] there, schools could run amok. Keeping tabs is important.” (Management, July 2004)

“ … [The consultant] is very strong and controlling, at times quite obstinate … On the one hand [this] personality has ensured that systems are tight, but on the other hand this personality has caused obstacles. Some schools may have been less willing and more resistant because of their relationship with [the consultant].” (Management, July 2004)

7.3 Norming

Through resolutions of earlier conflicts, the group reached the more harmonious norming phase. At this point, individuals should feel more comfortable with sharing their ‘real’ feelings and ideas, exposing perceived weaknesses and problems with the project and relying on the support of the group to see through this.

During the project’s earlier state of flux, it seemed that the existing members seized this unexpected opportunity to re-evaluate and re-affirm their roles within the group, and, in doing so, developed a greater and shared clarity of the project’s overarching aims:

“TEEP and SEP are trying to do two different things. TEEP is trying improve generic teaching skills and SEP is trying to modernise the science.” (Management, March 2005)

“We think of SEP as improving Sc1 through provision of resources and TEEP is the pedagogy side. So they do marry well.” (Management, March 2005)

Emerging from this turmoil seemed to be a collective responsibility over a more flexible, organic project with different individuals feeling they have the power to steer and contribute to the project’s evolution:

“In terms of its evolution, it has moved from being less prescriptive. And we have adapted to meet the needs of individual schools … Far more collaborative … Is more realistic.” (Management, March 2005)

Lines of communication between the external agency and the local authority became one of its strengths, facilitated through two overseeing directors at each end whose authority and lack of direct involvement freed them up to diffuse arising problems:

“I see that I have the ultimate responsibility. Although day to day was done through [a consultant], no decision was ever made without reference to me. Relationship between [the GTEP director] and myself has been strengthened throughout the year. Any issues that [the GTEP director] or I picked up were dealt with.” (Management, March, 2005)

“I feel as though as though I have been the steadying hand at the helm of a ship in stormy waters, since taking overall monitoring of the programme ... I have found at times people having extreme reactions to things and I have had to settle this. Initially I think this had to do with personality. I have found my role negotiating with [the key officer] very satisfactory. Lines of communication are clear and open.” (Management, March, 2005)

7.4 Performing

During the performing phase, significant progress is made towards achieving the project’s goals. Commitment to the project is rejuvenated, as accomplishments are measured and celebrated.

One aspect, pervading all the management interviews during this phase, was some discussion of the ways in which the original project had been tweaked and tailored in order to address the actual needs of the teachers involved. In some interviews, this was preceded by a realisation and recognition that the needs of teachers differ according to their professional experience and the geographical, cultural and socio-economic contexts within which they employ their skills:

“Don’t think we understood just how low standards in teaching were. For me going out and seeing the teaching going on gave me a new perspective. Doing what we did – putting that emphasis on TEEP – was necessary; focus on good teaching before SEP resources. We have addressed some areas of subject knowledge... But I think teachers need to be very confident in their delivery first, before focusing on this … Next year, how do we reorganise the activities to fit with the lower need? We are assuming they are ready for cutting edge stuff and they are not.” (Management, July 2004)

Extending training to technicians, setting up an EAL working party, re-thinking selection criteria for identifying key teachers and expanding the cascade model by offering twilight sessions and cluster meetings to departments to strengthen wider dissemination were some of the later initiatives highlighted in the management interviews. These were put in place in response to concerns identified by the evaluation, the participating teachers or the management group itself. This organic and responsive nature of the project, both within and between management structures, could be essential for initiating and sustaining widespread educational change driven by collaborative partnerships between an external agency and a LEA.

Identifying challenges and addressing them head on has chiefly been facilitated through the ‘grass roots’ work of the consultants. The role of the consultant – someone who can mediate between the external agency, the local authority and participating schools and teachers – was recognised as a vital component of the overall project by the management team. Furthermore, the calibre, efficiency and creativity of the particular two recruited consultants was recognised by both the external agency and the local authority:

“In Tower Hamlets [one of the successes is that we have recruited] highly trained inspirational consultants who have enthusiasm. Teachers can see that they can deliver content through Sc1.” (Management, March 2005)

“Consultants are key. Teachers benefit from in-house coaching and feedback.” (Management, March 2005)

And the participating teachers:

"The consultants have been really supportive – an extra pair of hands and a second mind to bounce ideas off … They keep pushing us along, keep us on our toes. We have developed a good relationship with them. Supported us with our INSET at school. You need these people to make it work … [The consultant] is always there, always keeping us on [our] feet. If you don't have consultants harassing you in this positive way then I am not sure if it will succeed." (Key teacher, June 2004)

Their work was always held in high regard which, as indicated in their interviews, seemed to spur the consultants on in ringing additional changes. Having respect for group members and celebrating their achievements may help to ease or prevent new obstacles and provide the extra motivation needed for a successful performing phase.

7.5 Adjourning

This final stage describes the period when a project starts to draw to close. Members of the team may experience both highs and lows at different points as roles become uncertain, forged relationships are broken and yet there is a tremendous sense of satisfaction with what has been achieved.

Amidst the preparations for a public celebration with the participating schools, occupying the thoughts of the entire management group, in their final interviews, was what needed to be done next in order to maintain change, once funding and external support was withdrawn. For some, the three-year duration of the project felt "sufficient to initiate but not long enough to sustain". And, with the ever increasing number of government strategies such as recent changes to the KS4 curriculum (21^{st} century science) all vying for schools' attention, one expressed concern was that "what you don't want this to become is just another initiative that we look back on and talk about fondly" (Management, 2006). As well as having an exit strategy in place, it was felt by some of the interviewees that overcoming this challenge would rely on the willingness and ability of the SMT/HoD to establish realistic systems to monitor and maintain good practice within their schools.

8. CONCLUSIONS

Tentative interpretations of evidence arising from this evaluation may have some powerful implications for how to strengthen the likelihood that a continuing professional development programme has the desired impact on teaching and the capacity to cascade this impact beyond just those selected for training.

The evidence that has emerged, from three years of classroom observations and participant teacher interviews, suggests that the project has changed the way in which science teachers across whole departments teach. Most substantially, students are spending over 20% more time learning science in an ICT-related context. The project has provided better and more ICT resources and supported this with professional development that has raised teacher confidence in using ICT. This has prompted teachers to find ways of incorporating ICT, for example real-life images and film clips, in science lessons that can help students see the relevance of science to their everyday lives and the contribution that science makes to the world at large. The project appears to have increased the percentage of time that students spend engaging in practical experimental activity and focusing on particular aspects of scientific enquiry, namely considering evidence. Notable rises in the mean average percentage of time that students are listening to each other, answering questions and working collaboratively in pairs or small groups during a science lesson could indicate that the project has had an impact on teacher perception of the nature and purpose of classroom talk. The emphasis seems to have shifted away from using talk solely for teacher exposition and administration of tasks and towards including talk to promote student-teacher and student-student interaction with a greater focus on dialogue for learning.

The observed changes in the classroom, which were found in year 7 science lessons, are mirrored in the participant teacher interviews which show similar trends in aspects such as ICT, scientific enquiry, group work and classroom talk. Armed, it now seems, with classroom strategies that excite and empower students to take greater ownership of their learning and strengthen this through collaborative interaction with their peers, these teachers have remarked on how their students seem more engaged and interested and enjoy doing science. Furthermore, there may be a connection between these observed classroom trends and the rise in student performance in KS3 science tests. These noticeable changes in teaching and learning might be because the project simply gave these teachers ‘official’ licence to take risks, use a variety of traditional and more innovative learning methods and enjoy teaching.

A closer inspection of each department in turn shows some variation, both in observation data (Appendix 7) and student performance. This suggests that impact might be a more complex and dynamic interaction between the proposed initiatives, the management involved in its introduction and design and the participating schools, teachers and students engaging with it. Within the context of the participating schools, several emerging factors may need to be considered when analysing each department. Department 1 had just been identified as a specialist science school at the start of the project. Funds preceding the project had already been injected into renovating the science classrooms with most already set up with a seating plan that promoted group work and interactive whiteboards. Departments 3 and 4, on the other hand, were still undergoing major building renovations, which were only completed around October 2005 for department 3. Science teachers, especially in department 3, faced many challenges in trying to implement change in these less desirable circumstances. One of the two key teachers left their schools at the end of the first year in departments 2 and 4. Another key teacher left the following year in department 3. With each departure, the local authority would quickly work on identifying and training up someone else within the department. Departments 2 and 3 each underwent an OFSTED inspection during the second academic year of the project. The Heads of Departments for 2 and 3 were both new to their posts at the start of the project. They were also identified as one of the key teachers for their school. In their later interviews, these teachers reflected on whether this position was beneficial for them and their departments. Departments 1 and 4 had two experienced HoDs already in place; in department 4, this teacher had 17 years of experience; in department 1, the acting HoD had 10. Although extremely supportive of the project, neither of these HoDs were selected as key teachers for their schools. In their interviews, they tended to see their roles as mentors, encouraging and developing other colleagues within their departments who, perhaps, had fewer commitments and were more willing to disseminate the project. The infective enthusiasm of the remaining key teacher in department 1 was commented on by other teachers within the department – citing this as one of the reasons why many of them decided to attend the non-compulsory twilight sessions, which were put in place to extend dissemination. These brief histories of the individual departments allude to the kinds of events, environments and factors that affect educational change.

Funding professional development initiatives adequately is key. In this case it raised the project's profile and status across all secondary schools in the local authority, helped to trigger teacher and senior school management interest and enthusiasm and maintain momentum. Funding enabled the recruitment of skilled consultants who ensured ongoing contact with the teachers, in between training days. Throughout the project, participant teachers could call on their support in implementing the programme's theoretical foundations into daily classroom practice and negotiate with the school's senior management for time and other resources on their behalf. The consultants were also in a position to mediate with the directors of the project, which created the opportunity to tailor the programme in response to the changing needs of the schools and teachers. Funding also provided extra resources for schools, in particular ICT equipment, and secured time for teachers to engage in pedagogical dialogue and reflect on their development.

Close contact with the schools and all teachers participating in the project was maintained throughout the project through the work of the consultants and the external evaluation. This contact provided a means of gaining real and relevant information about the actual level of teaching and expertise. Perhaps many professional development programmes are based on a premise that an experienced set of teachers engaging in continuing professional development will already possess a level of core skills and understanding which can be built on and refined. In this project, this assumption was challenged early on with a realisation and recognition that the needs of teachers differ according to their personal backgrounds, the variety of initial teacher training they receive and the geographical, cultural and socio-economic contexts within which they employ their skills.

Contact with the schools also revealed the extent to which the teaching and learning environment was impeding teachers' ability to implement change. In particular, major building renovations occurring in two of the schools and a lack of access to ICT and laboratory equipment and the general state of some classrooms became all the more apparent to the key teachers as their knowledge, awareness and understanding of the project's underlying philosophy grew:

"More things I could have done with respect to Sc1 and practicals but limited space in my room. Lack of space. After a year of so now they are doing the floor above me. Now I only have the length of a 3 m bench where groups can work [on practicals]. The ICT bit is not so well integrated into my lessons. I have no interactive whiteboard. OHP has been stolen so all I have is a laptop. My floor can't access the lift so getting equipment to my room is a problem. The learning environment is not conducive for learning – is really tatty – doesn't enthuse you to come to that room. But I have no choice. I have to try my best." (Key teacher, March 2005)

Using a cascade approach to ensure that impact on teaching filters out more widely, beyond just those selected to participate in professional development, has limited potential. For a cascade model that relies on teachers, once trained, going back to their schools to disseminate practice to succeed requires strategic features that strengthen this potentially weak model. In this project the trained teachers needed sufficient time first to become confident with their newly enhanced pedagogy. These teachers then needed ongoing support and further training for their additional coaching responsibilities. Schools and departments needed external input to set up systems (buddy teachers) that facilitate peer observations and to establish their own community of practioners (departmental INSET, joint planning). Further training was required on top of this to enable the wider teaching community to access a version (twilights) of the intensive professional development experience normally available to a select few. This cascade model also required regular monitoring and attention to ensure that the process was being carried through effectively and could be sustained within departments. And even having all these systems in place did not guarantee that the professional development gap between key, selected teachers and the wider teaching community was entirely closed, as the observation data show. Complex pedagogical change, associated with, for example, classroom dialogue and scientific enquiry, appears to be particularly sensitive to this approach.

The ongoing evaluation of the process was able to identify both the expected and unexpected different levels of impact that the process was having on teaching. The observation data helped to indicate how easily these different levels of impact were being transferred from one teacher to another. Collectively, the evaluation data suggest that different types of dissemination mechanisms such as departmental meetings, joint planning and peer observations might be required to cascade different levels of pedagogical impact. Some changes in practice such as using innovative tools (ICT) to enhance learning or resources that engage learners in a variety of ways might be easy to disseminate in one-off meetings and through informal conversations. Other changes such as collaborative learning, using student dialogue to facilitate understanding and teaching science through scientific enquiry are changes that tend to require a shift in perceptions and attitudes towards the roles of the teacher and learner in classrooms. These perhaps more complex and subtle forms of pedagogical change take time, over three years, to become fully imbedded and seem to require dissemination mechanisms like peer observations and regular departmental meetings that foster ongoing professional dialogue within a community of practioners.

The key teachers participating in this project recognised some of the challenges they faced in trying to cascade change across their departments. In their interviews, they identified some of the dissemination mechanisms that they felt would strengthen the process, such as peer observations and more departmental meetings for INSET, collaborative planning, reflection and review. Creating these kinds of professional development spaces within schools relied on the willingness and commitment of the senior management and HoDs who have the power to establish, maintain and monitor these kinds of internal school systems and can authorise attendance at external/residential training. From the onset, Tower Hamlets LEA have involved school senior management in the project through information days and termly departmental reviews. Schools' commitment to the project was made explicit and sealed, to some extent, through a contract made between the schools and Tower Hamlets LEA at the start.

Part of this project's success can be attributed to the organic and flexible form that it eventually took. Early setbacks due, at least in part, to a lack of clarity over a common vision and insufficient time to establish roles and responsibilities within the management team were overcome. The project's directors were willing and able to adapt and refine the project's aims and design in response to concerns arising from the ongoing external evaluation and identified by the consultants working closely with participating schools. Tailoring the project to meet the actual needs of the participating schools, teachers and students has helped to achieve an impact on science teaching and learning in the participating schools in the borough. Maintaining and extending this impact within schools may well require the expertise and commitment of the whole school community, including senior management and classroom teachers.

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APPENDICES

Appendix 1
Observation Schedule

		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	TOT.
	Time intervals	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	**TOT.**
Mode of organization																		
whole class																		
small group																		
individual																		
Pupils' activities																		
Listening	to teacher																	
	to pupil																	
Pupil(s)	answering questions																	
	asking questions																	
Producing text/diagram	copying (board, book or paper)																	
	free writing/drawing																	
Investigating	watching demo																	
	experimenting																	
Researching (resource based)																		
Other activity not above																		
Being managed																		
Having behaviour controlled																		
Use of IT																		
Engagement																		
Number of pupils off task at point observation																		
Percentage of class engaged																		
Sc.1. focus	using ideas+evidence in sci.																	
	planning																	
	obtaining+presenting evid.																	
	considering evidence																	
	evaluating																	

Appendix 2
Teacher interview

What do you think this project is about? How have you been getting information about the project? What kinds of support and training have you been offered by the department? LEA? How do you feel about the Gatsby project?

Have you noticed any changes in how you teach science? Tell me more about what kinds of things you think you are doing differently. Is there anything about your teaching that you think has stayed the same

What do you think have been the main challenges facing you, your department/ your school in making this project work? What kinds of support do you need to meet these challenges? Has this project had an effect on the way you work as a department?

What do you think are the main problems facing your pupils in their learning of science? Have you any suggestions for helping them? How do you think the project might help them?

How are the children responding? What kinds of effects on their learning have you noticed? What changes are you hoping eventually to see in the way they work and learn in science?

If you walked into a science lesson, what would you be looking for that might indicate that good science teaching and learning was going on?

Is there anything else you would like to tell me about?

Thank you very much indeed.

Appendix 3
Management interview

Roles
When did you acquire a role in this project? What part do you play? What do you do?

Do you feel your role has changed since?
What kinds of contributions do you feel you have made since the last interview?

Retrospective
a. Looking back since the start (or since the last interview), how, in your opinion, has the project evolved?
b. How did you feel at the start of the project?
c. How do you feel now?

Challenges and successes
What do you think have been the main challenges facing
- a. the Gatsby team,
- b. The LEA/learning Trust,
- c. schools,
- d. pupils

in terms of making this project work successfully?
What do you think are the successes so far?

Impact and changes
- a. What impact do you think this project has had so far on the teachers (Gatsby and non) so far?
- b. What impact do you think this project has had on the pupils so far?
- c. What do you envision/hope
  - i. the teachers
  - ii. the pupils

  will gain from project?

What next?
- a. What are the next steps for the project?
- b. What changes do you think need to be made to help the project work successfully in schools?

Appendix 4
Teacher questionnaire

Documenting the Tower Hamlets' work on KS3 science investigations

The information you provide in reply to the questions below will help the evaluation team to document the work on investigations at KS3.

The first section is about biographical details. We will only collect this information once. The subsequent pages are to do with the project and how it is going. We will be asking your opinions on the issues raised at approximately six monthly intervals.

Biographical details
The evaluation is by school department and not by individual teacher. So the information requested below will be used to characterise your science department.

Name:………………………………………………………………………………………...

Length of service in *this* school ……………………years

Total number of years teaching ……………………years

Number of other schools in which you have taught science. ……………………….

Responsibility in the department. ………………………………………………………..

Highest academic qualification ……………………………………………………….

Subject of first degree ………………………………………………………………

Highest teaching qualification……………………………………………………..

Place of initial teacher training……………………………………………………….

Project details
Please write down below what you think the project is aiming to achieve: put down what you think are the project goals.

Now write down what you think are the principal problems facing *your pupils* in learning science.

Please write below how you think the project may help your pupils learn science more effectively.

Appendix 5
Data from teacher questionnaires

Teacher profiles for each science department in cohort 1

Science department 1

TEACHER REF No	1	2	3	4	5 sup	6 sup	7	8	Total/ Ave
Service in this school (yrs)	3	5	11	8	0.25	0.6			4.6
Total yrs teaching	3	14	25	10	2	6			10
No of other schools taught in	0	1	0	1	3	6			2
Responsibility post?	N	y	Y	Y	N	N			
What?		KS3	Deputy head/line manager	Act HoD					
HIGHEST ACADEMIC QUALIFICATION									
PhD									
MPhil		x							
MSc									
MA			x						
BSc	x			x	x	x			
BA									
SUBJECT									
Biology	x			x	x				
Chemistry		x				x			
Physics									
Pharmacology									
Biochemistry									
Psychology			x						
Maths			x						
HIGHEST TEACHING QUALIFICATION									
PGCE	x	x		x		x			
BEd									
PGTC					x				
NPQH			x						
PLACE OF ITT									
University Ed faculty	x	x			x-RSA?	x			
College			x						
School-based				x					

Science department 2

TEACHER REF No	1	2	3	4	5	6	7	8	9	Total/Ave
Service in this school (yrs)	2	3	10	10	2	7	2.5	0.5	6	5
Total yrs teaching	3	10	12	34	2	7	2.5	0.5	7	8.6
No of schools taught in	1Pri	2	2	5	0	0	1	0	2	1
Responsibility post?	N	y	Y	N	N	N	N	N	Y	
What?		HoD	2nd in faculty						CASE/pri	
HIGHEST ACADEMIC QUALIFICATION										
PhD								x		
MPhil										
MSc		x								
MA				x						
BSc	x		x				x		x	
BA					x	x				
SUBJECT										
Biology									x	
Chemistry										
Physics		x		x	x					
Pharmacology			x							
Biochemistry			x			x	x	x		
Psychology	x									
HIGHEST TEACHING QUALIFICATION										
PGCE	x	x	x		x	x	x	x	x	
BEd										
PGTC										
Dip Ed				x						
NPQH										
PLACED OF ITT										
University Ed faculty	x			x	x		x	x	x	
College		xR				xG				
School-based			x							

Science department 3

TEACHER REF No	1	2	3	4	5	6	7	8	Tot/ Ave
Service in this school (yrs)	5	0.2	6	7	2.5	0.2	0.2		3
Total yrs teaching	8	6	6	12	8.5	0	0		5.7
No of schools taught in	4	2	1	8	4	3	2		3
Responsibility post?	y	y	n	y	n	n	n		
What?	2nd in charge	HoD		KS4					
HIGHEST ACADEMIC QUALIFICATION									
PhD									
MPhil				x					
MSc									
MA									
BSc	x		x				x		
BEng		x							
BA						x			
Diploma					x				
SUBJECT									
Biology									
Chemistry	x		x						
Physics		x		x					
Biochemistry						x			
Zoology							x		
ICT/software en					x				
Mechanical en		x							
HIGHEST TEACHING QUALIFICATION									
PGCE	x	x	x	x		x	x		
BEd					x				
PLACED OF ITT					India				
University Ed faculty		x			X?	x			
College	xG		XG	xG			x		
School-based									

Science department 4

TEACHER REF No	1	2	3	4	5	6	7	8	9	Tot/ Ave
Service in this school (yrs)	0.2	0.2	3	1	3	2	26	3	14	6
Total yrs teaching	5	4	17	2	3	1+(PGCE phase 2)	27	9	24	10.2
No of schools taught in	2	2	2	-	1	1	1	4	3	2
Responsibility post?	y	y	y	n	n	y	n	n	n	
What?	Dep. HoD	Post-16	HoD			G&T				
HIGHEST ACADEMIC QUALIFICATION										
PhD										
MPhil						x				
MSc				x						
MA									x	
BSc		x			x		x	x		
BA			x							
BEng	x									
SUBJECT										
Biology										
Chemistry			x			x		x		
Physics		x					x			
Pharmacology					x					
Aeronautical Engineering	x									
Integrated land use system				x						
Health education									x	
Zoology									x	
HIGHEST TEACHING QUALIFICATION										
PGCE	x	x	x	x	x	x	x	x	x	
BEd										
PLACED OF ITT										
University Ed faculty	x		x	x	x	x		x	x	
College		xG					xG			
School-based										

Analysis of responses to open questions on questionnaire

Number of questionnaires collected from individual participating science teachers during each academic year of the project is referred to as n. Statements in bold are additions to the original categories established in year 1 from open coding of the responses from teachers in cohort 1 in year 1 of the project.

1*) Please write down below what you think the project is aiming to achieve put down what you think are the project goals.*

Response	Cohort 1 Year 1 (n=32)	Cohort 1 Year 2 (n=24)	Cohort 2 Year 2 (n=13)	Cohort 1,2,3 Year 3 (n=28)
Sc1	75%	46%	38%	25%
Improve science teaching and learning	28%	21%	23%	21%
Raising attainment at KS3	19%	17%	38%	7%
No response/not sure/don't know	25%	25%	8%	21%
TEEP 6-part cycle	-	17%	8%	4%
Interactive teaching and learning	-	21%	15%	21%
Other (life long, independent learners, increase motivation)	-	17%	15%	36%
ICT	-	13%	0%	4%

2) Now write down what you think are the principal problems facing your pupils in learning science

Response	Cohort 1 Year 1 (n=32)	Cohort 1 Year 2 (n=24)	Cohort 2 Year 2 (n=13)	Cohort 1,2,3 Year 3 (n=28)
Literacy/language/**being able to communicate ideas in science lessons**	44%	63%	23%	29%
School science irrelevant to everyday life	22%	25%	31%	25%
Understanding science concepts	22%	21%	15%	25%
Lack of enthusiasm/motivation for learning	19%	42%	54%	29%
Lack of resources/ICT	-	33%	23%	18%
Lack of home support	-	13%	15%	7%
Numeracy	-	8%	8%	7%
Other	-	17%	31%	36%
No response/not sure				14%

3*) Please write below how you think the project may help your pupils learn science more effectively*.

Response	Cohort 1 Year1 (n=32)	Cohort 1 Year 2 (n=24)	Cohort 2 Year 2 (n=13)	Cohort 1,2,3 Year 3 (n=28)
Get new ideas for teaching-	53%	46%	38%	46%

strategies (**VAK, group work, ICT**)				
Give me ways to motivate pupils (**active/independent learning**) & make work more relevant	50%	36%	46%	32%
Improve understanding/awareness/skills of Sc1	31%	13%	31%	4%
Changes to schemes of work /**TEEP lesson structure**	9%	13%	38%	50%
More resources	16%	21%	31%	18%
Improve thinking	16%	0%	8%	7%
No response/not sure	22%	25%	15%	21%

Appendix 6
Observation data

Pupils' activities	Overall 2003	Overall 2004	Overall 2005
Listening to teacher	37	34	33
Listening to pupil	23	25	38
Answering questions	18	19	23
Asking questions	2	4	5
Copying	6	8	5
Free writing/drawing	15	16	23
Watching demo	5	5	2
Experimenting	16	9	24
Researching	1	3	6
Other	3	13	11
Being managed	24	26	25
Having behaviour controlled	4	2	3
IT	2	17	27
Using ideas + evidence	0	1	0
Planning	3	2	4
Obtaining + presenting evidence	17	11	19
Considering evidence	2	3	7
Evaluating	0	0	0

Pupils' activities	key 2003	key 2004	key 2005
Listening to teacher	43	32	33
Listening to pupil	28	33	53
Answering questions	20	25	28
Asking questions	1	8	3
Copying	4	1	0
Free writing/drawing	16	20	12
Watching demo	6	4	2
Experimenting	17	13	38
Researching	0	0	2
Other	3	21	7
Being managed	26	23	24
Having behaviour controlled	2	2	2
IT	2	20	31
Using ideas + evidence	0	0	0
Planning	2	2	0
Obtaining + presenting evidence	22	11	31
Considering evidence	1	2	10
Evaluating	0	0	0

Pupils' activities	Non-key 2003	Non-key 2004	Non-key 2005
Listening to teacher	30	34	33
Listening to pupil	18	23	34
Answering questions	16	18	22
Asking questions	3	3	5
Copying	7	9	6
Free writing/drawing	14	15	25
Watching demo	5	4	2
Experimenting	14	9	19
Researching	1	4	8
Other	4	12	13
Being managed	22	27	24
Having behaviour controlled	6	2	3
IT	2	14	25
Using ideas + evidence	0	1	0
Planning	3	2	5
Obtaining + presenting evidence	11	10	14
Considering evidence	2	2	7
Evaluating	0	1	0

Pupils' activities	Dept 1 2003	Dept 1 2004	Dept 1 2005
Listening to teacher	38	41	34
Listening to pupil	19	29	36
Answering questions	16	14	20
Asking questions	1	3	2
Copying	2	2	4
Free writing/drawing	10	14	16
Watching demo	4	2	2
Experimenting	27	13	30
Researching	2	0	2
Other	0	15	6
Being managed	25	32	28
Having behaviour controlled	3	5	2
IT	0	39	40
Using ideas + evidence	0	2	0
Planning	4	2	0
Obtaining + presenting evidence	23	17	32
Considering evidence	0	0	6
Evaluating	0	0	0

Pupils' activities	**Dept 2 2003**	**Dept 2 2004**	**Dept 2 2005**
Listening to teacher	34	33	33
Listening to pupil	22	17	37
Answering questions	17	16	17
Asking questions	3	2	1
Copying	15	11	5
Free writing/drawing	16	19	25
Watching demo	5	5	0
Experimenting	13	7	19
Researching	0	8	3
Other	2	15	17
Being managed	22	25	22
Having behaviour controlled	7	2	1
IT	0	7	16
Using ideas + evidence	0	0	0
Planning	4	4	7
Obtaining + presenting evidence	24	11	10
Considering evidence	2	2	3
Evaluating	0	0	0

Pupils' activities	**Dept 3 2003**	**Dept 3 2004**	**Dept 3 2005**
Listening to teacher	36	33	29
Listening to pupil	26	30	39
Answering questions	27	23	26
Asking questions	1	5	7
Copying	4	15	9
Free writing/drawing	13	11	23
Watching demo	10	5	4
Experimenting	4	5	24
Researching	0	0	7
Other	1	5	4
Being managed	26	20	26
Having behaviour controlled	6	2	6
IT	1	9	24
Using ideas + evidence	0	0	0
Planning	1	2	7
Obtaining + presenting evidence	6	4	14
Considering evidence	1	6	8
Evaluating	0	0	0

Pupils' activities	**Dept 4 2003**	**Dept 4 2004**	**Dept 4 2005**
Listening to teacher	37	31	35
Listening to pupil	23	25	39
Answering questions	11	22	29
Asking questions	2	6	9
Copying	3	5	1
Free writing/drawing	19	18	26
Watching demo	1	7	1
Experimenting	18	12	21
Researching	0	3	12
Other	10	18	15
Being managed	22	27	22
Having behaviour controlled	1	0	1
IT	5	13	28
Using ideas + evidence	0	2	1
Planning	2	1	1
Obtaining + presenting evidence	16	12	18
Considering evidence	3	2	12
Evaluating	0	1	1

Appendix 7
Observation figures showing average percentage of time students are involved in different activities during a science lesson over three years for each science department

Figure 7.1
Average percentage of time students are involved in different activities over three years for science department 1

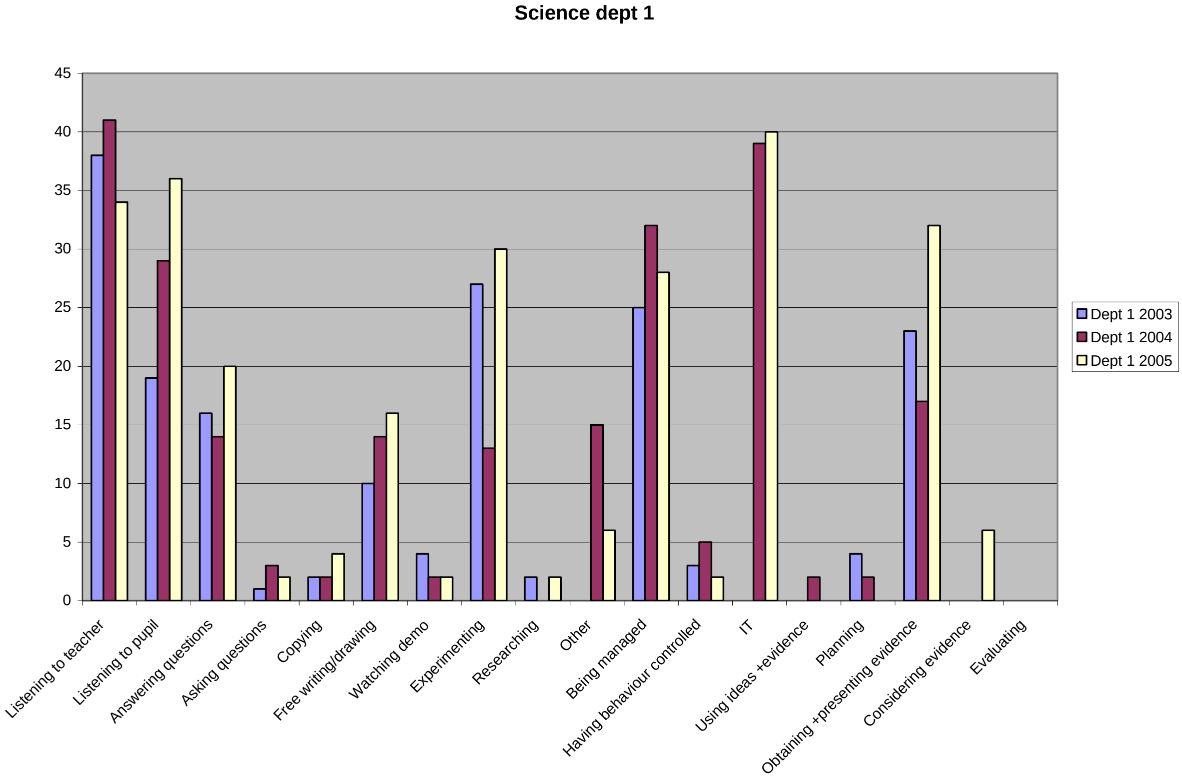

Figure 7.2
Average percentage of time students are involved in different activities during a science lesson over three years for science department 2

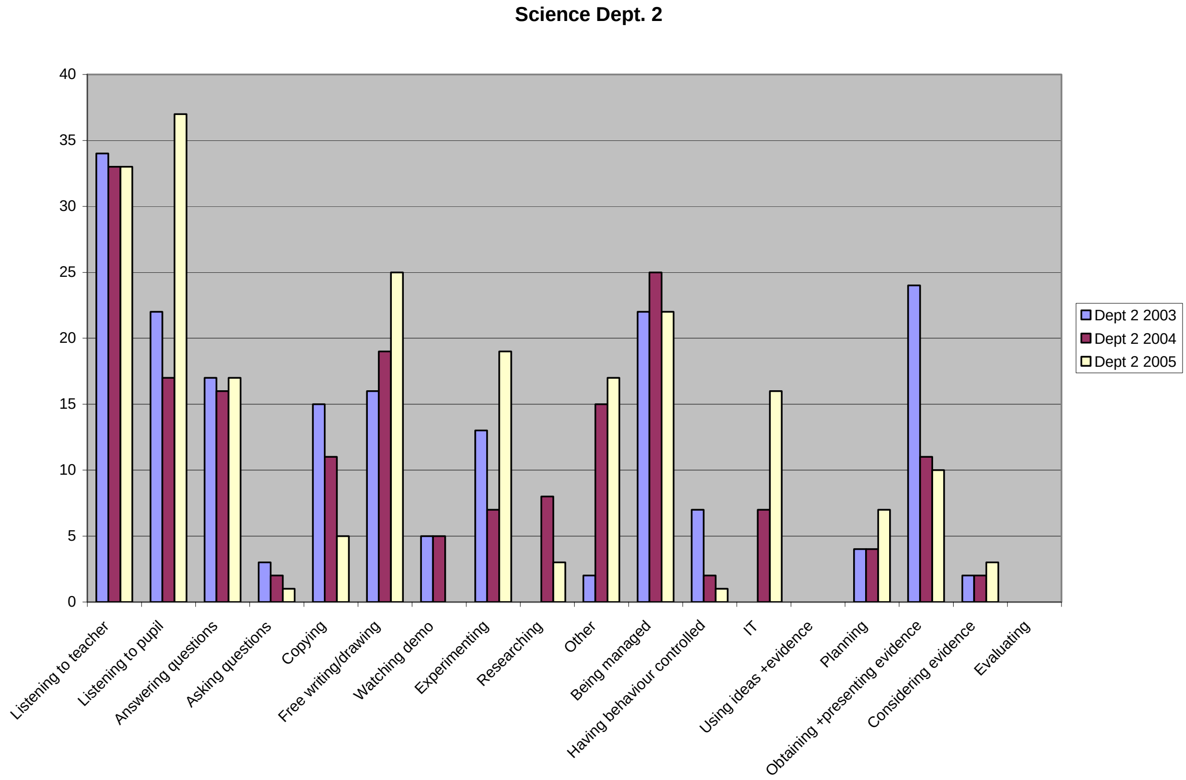

Figure 7.3
Average percentage of time students are involved in different activities during a science lesson over three years for science department 3

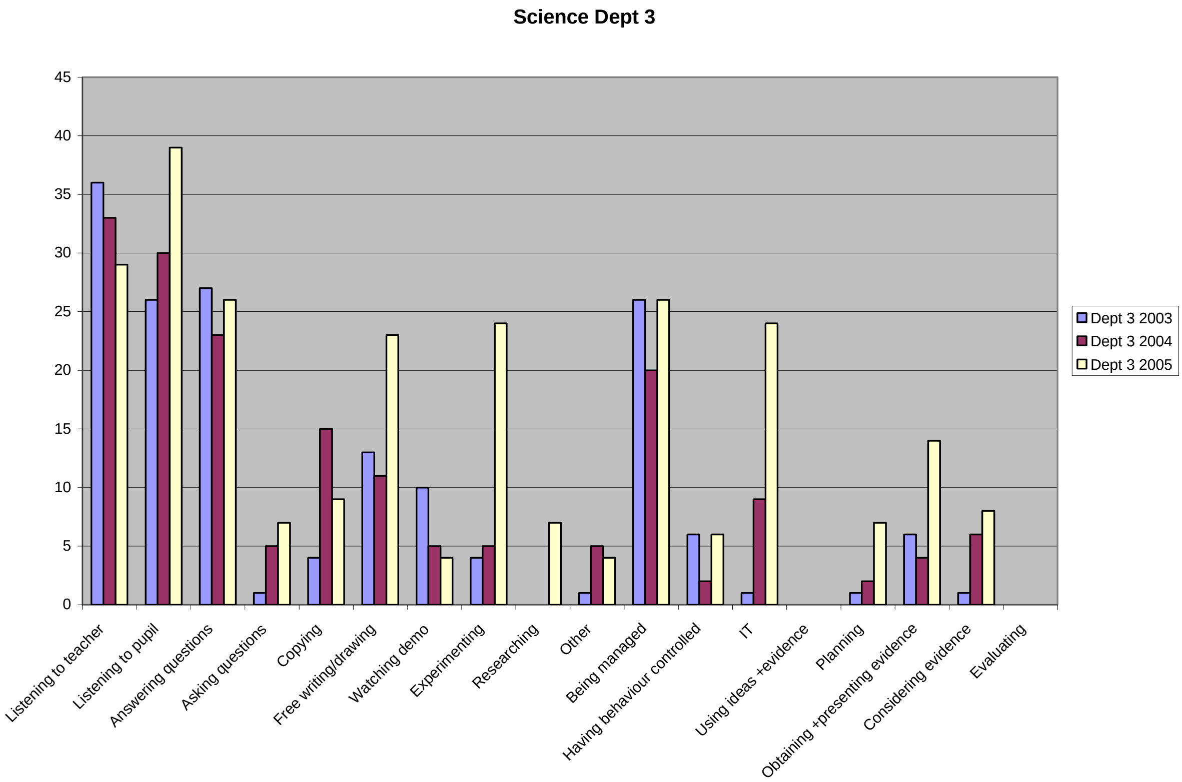

Figure 7.4
Average percentage of time students are involved in different activities during a science lesson over three years for science department 4