




Teachers' Experiences of the teaching of Personal Capabilities through the Science Curriculum

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Unpublished PhD Thesis, July 2002





The PhD studentship for this study was funded by the Centre for Science Education, Sheffield Hallam University.

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This study of teachers' perceptions and experiences of the teaching of Personal Capabilities (PCs) through the Science curriculum, documents the process by which they were successfully enabled to integrate PCs into their subject teaching.

ABSTRACT

An action research methodology provided the basis for the development of the study which benefited from flexible, collaborative partnerships between teachers and the researcher. Facilitation and support prompted action and continuous reflection on research interventions, their outcomes and influence on pedagogy, student development and learning. Emphasis on regular teacher-researcher interactions during curriculum innovation had significant implications on teachers' professional development, and was critical in affecting pedagogic change. Collaborative partnerships emerged as a powerful tool for understanding the teaching and learning of PCs.

Semi-structured interviews and questionnaires, classroom observations, reflective logbook entries and discussions formed the main sources of data represented in case studies, which provide contextualised representations of teacher activity.

Using ten operationally-defined PCs it was shown that students' personal development can be enhanced through the Science curriculum. A process model including: knowing, self-assessing, action planning, acting and reviewing, illustrates the teachers' and students' actions during PC development. Strategies for facilitating students' PC improvement are illustrative of the teachers' modified pedagogic approaches to subject teaching, which encouraged self-awareness and prompt behavioural change.

Findings from this study suggest further research and provide recommendations for policy makers, teachers and educational researchers, whilst highlighting the constraining nature of current National Curriculum (NC) assessment strategies.

BACKGROUND

The study stemmed from an interest in youngsters' personal, social and academic development in schools. The researcher was particularly interested to explore the links between these areas of development, and how Personal Capability (PC) development could be effectively combined with mainstream Science teaching in lower-secondary school. Parallel studies in eight primary schools reinforced these findings for younger children. Indications of concerns, arising from the review of contemporary teaching practices (Jenkins 2000a, Donnelly 2000c), coupled with the increased demands for generic skill development in employment-related literature (Department for Trade and Industry 1998), was also a key driver of interest in PC development.

It was considered that:

1. students' personal characteristics, coupled with, and enhanced through subject knowledge acquisition, might lead to generally more 'effective' students, lifelong learners and overall individuals
2. subject teachers were being steered towards delivering subject content knowledge, with little or less emphasis on integrating personal development, due to external constraints and influences
3. all students should be provided with regular opportunities to develop their Personal Capabilities within regular Science teaching. It was considered fundamental that science teachers should highlight and facilitate the development of a range of broader skills and characteristics.

AIMS

The study was built around three main aims.

1. **To establish the relevance and operational definitions for the Personal Capabilities for use within a curriculum context.**
2. **To investigate the extent to which practice at school and classroom levels enables the integration of Personal Capabilities through the Science curriculum.**
3. **To research teachers' experiences and perceptions of the teaching and learning of Personal Capabilities through the Science curriculum.**

THE PERSONAL CAPABILITIES

The generic life-work skills and characteristics that are considered influential to the social, academic and professional lives' of individuals.

Demonstrating personal capability refers to individuals' capacity to demonstrate the behaviours associated with the skills and characteristics of:

- **positive self-image:** Valuing oneself and one's achievements
- **self motivation:** Being able to motivate oneself to do what needs to be done
- **problem-solving:** Being able to analyse a problem and form strategies to work towards a solution
- **creativity:** Being able to think of and share new or novel ideas
- **verbal communication:** Being able to communicate one's opinions and feelings appropriately, by means of the spoken word
- **critical thinking:** Being able to critically review and evaluate practice in order to improve

- **social intelligence:** Being able to respond appropriately to different situations and people
- **teamwork:** Being able to work well in teams
- **self management:** Being able to take charge of one's own learning
- **tenacity:** Being able to persevere at a task in order to meet deadlines.

The study considers the PCs to be non-subject specific and to be applicable across a range of curricular and non-curricular activities. The PCs framework is non-hierarchical and *not exhaustive* of the range of skills that can contribute to personal success. It is recognised that differences in interpretation will arise across varying contexts, cultures and age groups and that circumstance and age play an influential role in determining appropriate behaviours for the PCs.

APPROACH

The research spanned a 3-year period, with the involvement of a wide study group including the researcher, supervisors, advisors, teachers, students and employers.

Implicit in the research approach was the notion of teachers as action researchers, focusing on reflection-in and on-action (Schon 1983). Teachers were encouraged to be integrally involved in reviewing Science teaching practices, tailoring and adapting resources and interventions, and focusing and sharing evaluation on their perceptions and experiences. Establishing teachers' sustained support was central to the study, and required a high level of voluntary commitment to gain substantiated understandings of the strategies and influences on students' PC development. A positive contribution to teachers' professional development was inherent in their involvement, where the undertaking of the research was coupled with reflection on personal understandings, pedagogy and curriculum change.

Qualitative research methods of semi-structured interviews, questionnaires, surveys, observations and diaries provided the main sources of data. Analysis and interpretation was undertaken primarily by the researcher, in association and collaboration with the teachers and supervisory and advisory teams. The collaborative nature of data collection and interpretation facilitated teachers' sense of ownership and involvement in the study, encouraging openly reflective discourses to be maintained between the teachers and the researcher. As teachers' involvement in the study continued, and understanding of PCs improved, reflections on experience became more detailed and were articulated more clearly in relation to their personal development, that of their students, and the impact on teaching and learning. Collaboration between and across schools, encouraged teachers to consider their experiences with others, enabling increased clarity and objectivity of thought and interpretation.

SCHOOL CONTEXTS

The school contexts differed in various ways and were also significant for the development of the research. The schools' socio-economic status, levels of student attainment, management and departmental support, teacher involvement and the status of staff, were factors which were acknowledged and documented within the case studies. It was considered essential to recognise and report the influence of school contexts, so that the generalisability and representativeness of the outcomes was better informed.

THE RESEARCH SAMPLE

A group of 16 teachers from 7 secondary schools, 1 primary school and 1 business-funded education centre became involved in the study. They took part on a voluntary, non-funded basis for a period of at least 18 months. The schools were based within six LEAs and the teachers formed a core study group with supervisors, advisors and university staff contributing to the wider study group.

Of the 16 teachers, 12 were Science specialists with a variety of additional management and pastoral responsibilities. All the teachers, with the exception of one primary school teacher, conducted the research with students from Key Stage 3 (Years 7, 8 and 9), with occasional support and interest from other members of department and classroom support staff. The four additional teachers were drawn from Mathematics and Design and Technology (DT) departments in one of the participating schools. The way each teacher integrated the research into their teaching is outlined in case study reports.

THE 5-PHASE RESEARCH STRATEGY

A five-phase process represents the research programme, and although presented in linear form, was an ongoing cyclical process of intervention, consideration, adaptation and review. Progress in each phase was subject to regular review and evaluation, and was conducted alongside ongoing literature searches, analysis of data and consultation with the wider study group.

Phase 1: Literature Review & Employer-Teacher Survey

The first phase of the study consisted of extensive literature searches and reviews to highlight a range of competences and 'transferable' skills which are considered to be influential to personal success. By listing the skills and identifying the similarities between them, a working framework of ten PCs emerged. Increased understanding of the nature of each PC enabled their definition. In order to clarify the definitions, desirable behaviours associated with each PC were identified and phrased as positively focused objectives (**the behavioural framework**). A consensus of understanding was gained through formal and informal discussions with teachers, advisors and supervisors.

Further definition of the PC objectives came through developing a '**discussion document**', focused on illustrating progressive development in behaviour using a four-point scale. This document primarily aimed to illustrate, to teachers and students, how progression in PCs 'could' occur. The behavioural objectives were differentiated into four progressive statements rated in terms of

the frequency of their display. The document aimed to stimulate student-student, and teacher-student reflection and discussion.

The identification of behaviours prompted improved understanding and awareness of PCs, and encouraged teaching, target setting and review to be focused on a consistent range of desirable academic and PC outcomes.

Three forms of data collection were used to gain teachers' and employers' opinions on the framework and concept of PCs. Postal questionnaires targeting a random sample of 100 schools (both primary and secondary age phases) and 50 employers, were accompanied by a short verbal random-sample survey of 62 participants. 21 follow-up interviews were undertaken (15 teachers; 6 employers). Data was processed and analysed using NUD·IST Vivo (a computerised data analysis package), which enabled the coding and sorting of the qualitative statements in order to draw out emergent themes.

Phase 2: Designing and adapting teaching and learning

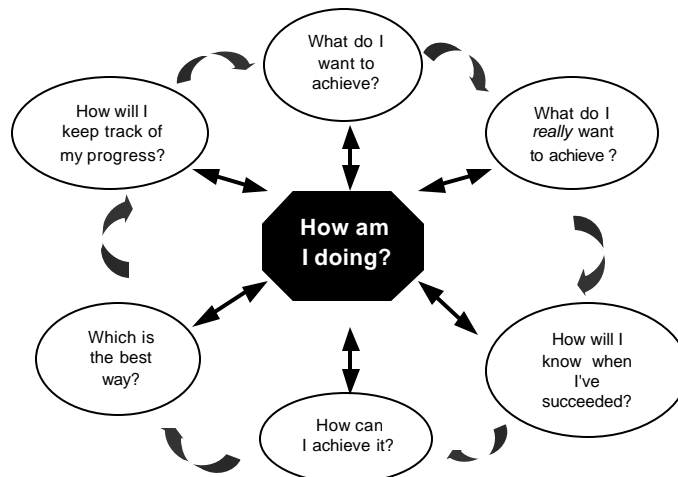
Three generic research interventions were devised and curriculum materials adapted to encourage students' PC development within regular Science teaching.

Intervention 1: Making PCs explicit

Teachers were encouraged to teach lessons targeting PC development, with increased verbal, practical and visual emphasis on particular PC behaviours. The PC behaviours were integrated into Science schemes of work, students' worksheets and classroom displays, and both teachers and students were encouraged to be increasingly conscious of opportunities to actively promote, discuss, reflect on and review PC development during Science.

Intervention 2: The GRASP® framework

GRASP (Getting Results and Solving Problems) was offered as a thinking skill strategy to accompany and promote PC development. Teachers were encouraged to identify and make explicit academic and PC targets for a lesson, following which the framework aimed to encourage pupils to take ownership for their learning and PC development.



Intervention 3: Student self-assessment

A cyclical process of target setting, review and evaluation was promoted as a method of self-assessment for PCs, and as a means of tracking student improvement. Students were encouraged to highlight and discuss their PC strengths and areas of development using the discussion document and associated self-assessment materials. Students were invited by their teachers to regularly target particular areas for improvement, commit themselves to improvement and self-assess through verbal and written evaluative statements.

Phase 3: The Pilot Study

A pilot study was conducted with 600 students and 12 teachers to trial and evaluate frameworks for students' PC self-assessment. It reviewed the manageability of the frameworks from teacher and student perspectives and reported on their effectiveness in aiding target setting and recording PC development.

Phase 4: Data Collection

During the second year of study, data collection took place in all 7 schools using a variety of qualitative techniques. Interviews, questionnaires, observations and reflective diaries provided the main sources of data, eliciting and exploring teachers' experiences and perceptions of the integration of PC interventions into the teaching of Science.

Phase 5: Data Analysis - Grounded Theory and Case Study

Data was analysed by processes typical of grounded theory methods - sorting, coding and categorising, identifying, clarifying and substantiating findings. Emergent themes and commonalities were sought within the data using constant comparative analysis, such that key strategies for the teaching and learning of PCs emerged.

Data from each school was processed and collated into separate explanatory case studies, providing a descriptive illustration of the context, experiences and perceptions. These case study reports outline the action research process, based on all the data collected on the teachers' and researcher's experiences and perceptions.

The final analysis of cases was undertaken mainly by the researcher. Processes of description, explanation, verification and validation were underpinned by reflection, in order to clarify and justify outcomes. Referral to, and reflection on, the study's aims and objectives assisted the clarification of key outcomes and areas of further interest.

FINDINGS

The findings suggested a significant discrepancy between the demand for PCs as perceived by teachers and employers, and the level of provision for the development of youngsters' PCs at school and on entering the workplace. The data suggested that as the demand for PCs increases, largely due to their increased desirability by employers, so too will the need for youngsters to improve their PC development to maximise job opportunities and overall

personal success. Presently, employers consider that PC development in new employees falls below that required. Responses from employer and teacher groups indicate that they see the responsibility for youngsters' PC development as lying predominantly with schools and with parents. On entry to the workplace employers seek technical skills, academic qualifications and also proficiency in PCs.

Teachers and employers considered that PCs are becoming increasingly relevant in the 21st century workplace. They consider that rapid advancements in technology, and demands for superior services, are resulting in employees needing varied and adaptable generic skills. This data supports that presented in related works (DTI 1998, Leadbeater 1999, Seltzer and Bentley 1999).

Recommended strategies for PC development

The research illustrated that teachers can influence students' PC development through the following strategies: making PCs explicit; target setting and evidence gathering through monitored self-assessment; adapting and devising teaching and learning strategies; providing regular feedback; differentiation; pupil PC challenge scenarios. Resources were devised to support these activities which provides the focus for this chapter.

Strategy 1: Making PCs explicit

Making PCs explicit in lessons was found in all cases to be especially significant during their introduction, when teachers discussed the PC behaviours and how they were associated with task success. Teachers identified class or individual targets, drawn from the behavioural framework, and encouraged students to discuss their meaning and consider methods for improvement, prompted by visual displays and activities. Explicit target setting and the regular formative feedback by teachers, peers and parents, increased the status and value of PCs within students' subject learning. Most students reacted positively, investing effort in the attempt to display the desirable behaviours.

Focusing on PCs alongside subject knowledge encouraged students to appreciate 'how' their behaviour influenced 'what' they learnt. Students increasingly recognised the influence of their PCs on their learning, as their understanding improved, and their self-confidence and sense of personal responsibility towards learning and PC development was enhanced. It was recognised that development was an on-going process, and achievement related to the level of effort and motivation students invested, as well as to academic ability and self-image.

Maintaining students' awareness of PCs seems to be central to influencing sustained PC development, and is related with metacognitive development – a process enhanced by the improved understanding of the expected outcomes of learning.

Strategy 2: Target-setting and evidence gathering using monitored self-assessment

The process of self-assessment was not solely the responsibility of the student, but was monitored, shared and discussed with others to improve the objectivity, clarity and usefulness of evidence. Teachers, peers and parents were encouraged to become involved in the process, providing students with a view of how others perceived their performance.

Target Setting: raised students' awareness and understanding of PCs. Targets were set by teachers as whole-class lesson objectives, and by students as personal goals for improvement, through their incorporation in worksheet design, classroom display and lesson introductions.

Using the PC behaviours as pre-prepared targets, two approaches to target setting were regularly used to identify and review PC development:

- *use of the discussion document*

Discussion with peers or teachers enabled students to identify and justify their perceived personal strengths and areas of improvement. The use of the document was sometimes viewed as time-consuming, and best suited to introductory or longer review activities.

- *use of a self-assessment profile*

Most commonly target setting resulted from regular self-assessments which proved manageable in lesson time. These relied less heavily on discussion, encouraging students to rate their ability in relation to core PCs, on a four-point scale. The triangulation of personal assessments from teachers, peers and parents, enhanced the reliability of the outcomes from which targets were set.

Evidence gathering: Having targeted key areas for improvement, and undertaken activities to support their development, students provided evidence of their progress. The evidence took the form of short paragraph statements describing activities, often undertaken in Science lessons, during which the students felt they had displayed or had endeavoured to improve their target.

Lengthy periods of time between the activity and the assessment hindered their ability to recall events, and so, short, two to three minute review activities were introduced directly following a lesson, between two and five times per week. It became clear that the majority of students required training before independently undertaking the task.

Most teachers found target setting and self-assessment a time-consuming process impinging on subject teaching time. As students became more familiar with the tasks, their ability to undertake PC activities improved, and teachers were increasingly confident to allocate the activity as homework tasks. In this way, parents were encouraged, and undertook some work with their children to provide feedback and support. Teachers also reviewed the work giving additional feedback and direction.

Strategy 3: Adapting teaching and learning strategies

Integrating PCs into subject teaching required teachers to review how their practice influenced students' PC development. Reflection on practice, with

analysis of Science schemes of work, resulted in learning opportunities being identified which already encouraged PCs, albeit implicitly. Activities encouraged students to take increased responsibility for their learning, and they were often required to work cooperatively with their peers to disseminate or share knowledge and understanding.

Increasing students' responsibility resulted in emphasising activities which encouraged autonomy, choice and decision-making. These were often characterised by student-centred or active teaching and learning approaches which depended on students' self-motivation, tenacity and ability to plan and structure their own work.

Project Work: varied across the cases, from integrated cross-curricular projects to shorter independent research activities and were identified as teaching styles which effectively encompassed academic and PC development. Commonly, subject knowledge was presented in relation to 'real-life' contexts, or drew on students' personal interests. Project tasks were flexible and open-ended, requiring time to generate, research, investigate and present ideas and knowledge. Where project work was used as a main teaching strategy, it benefited from the relaxation of curriculum structures, which allowed for longer periods of activity.

Co-operative work: during learning became a strong focus of PC development. Teachers found this to be a means of facilitating the development of teamwork, verbal communication and self-management PCs, using subject knowledge as a context. The use of buddies, pairs, small groups or teams during Science investigation or problem-solving activities furthered opportunities to develop critical thinking and problem solving behaviours.

Working collaboratively students noted increased responsibility towards their learning and their peers, and were reluctant to negatively influence the group or team's success. Most students valued the opportunity to work collaboratively in less formal environments.

Where curriculum pressures required the completion of schemes of work to cover prescribed activities, the use of extended co-operative work was also less frequent. Short, paired or small group activities were more common, with emphasis placed on verbal communication and teamwork PCs.

Student Buddy Partnerships (Buddies): were introduced to aid co-operative activities, and especially benefited the development secure working relationships between two students over extended periods of time. Partnerships were voluntarily chosen, unless disruptive students inhibited their working relationship. They were used frequently in discussions in pairs, larger groups or whole class activities, and encouraged students to trust and have confidence in themselves and their partner. Buddies also acted as peer assessors and reflective partners for PC development, providing a continuous view of their peer's development. The impact of buddy partnerships related to positive self-image, verbal communication, teamwork, self-motivation and social intelligence behaviours.

Investigative/ Problem-solving activities: were typical of the Science focus in this study. Teachers valued opportunities for students to actively, and often practically, work collaboratively on investigations requiring information to be researched and located, and to undertake short experiments. Problem solving activities varied from short puzzles to lengthier activities requiring the design and construction of artefacts, where analytical and strategic thinking skills were required, as well as PCs of problem solving, critical thinking, creativity and self-management. These more integrated, open-ended activities were time-intensive but were found to promote significant benefits.

Modelling PC activities: encouraged students' understanding of PCs which aimed to illustrate actions, strategies and specific behaviours, leading towards improved understanding and proficient performance of PC behaviours. Students increasingly benefited from role modelling exercises which involved mock scenarios, and illustrated how particular PCs were transformed into actions in realistic, classroom situations. Role modelling enabled students to see, in direct actions, how improvement could be achieved.

Strategy 4: Providing regular feedback

The monitoring of students' activity and effort towards their PC development allowed them to appreciate and value the contribution of PCs towards self-improvement and learning. Students benefited from being regularly taught, encouraged and praised to display behaviours, reinforcing their self-awareness and personal development. Feedback and reward were necessary to maintain motivation towards tasks and PC targets.

Feedback took different forms, from teacher's verbal comments, students' self-assessments, reflective discussions with peers or buddies, to parents' comments. Most significantly teachers provided 'on the spot' formative feedback during lessons or through the marking of work which related primarily to whole-class or personal targets.

The PC behavioural statements encouraged a generic language which was more readily understood by those involved, improving and reinforcing awareness and understanding of generic concepts, such as teamwork, self-management, critical thinking etc. Specific feedback emphasised the value of desirable behaviours

Strategy 5: Differentiation

Differences in students' ability to understand and react to the PC interventions generally correlated with their academic ability. Students with lower academic ability found difficulty in interpreting the meaning and relevance of PCs, often viewing them as unrelated to their subject knowledge development. Many suffered from poor basic literacy skills, which hindered the reading and writing elements of self-assessment tasks. Some students, however, performed equally well as their higher ability peers, in identifying and self-assessing PCs, especially on a verbal basis and when assisted by the teacher.

Academic ability was thought to significantly influence students' self-image and self-confidence, which in turn seemed to affect their approach to PC

development. Higher ability students, who exhibited a positive self-image, seemed better able to target additional features of their development, differing from lower ability students who seemingly lacked confidence or drive. This does not suggest that PC development is better suited to higher ability students, rather that development for those of lower ability requires more time, specific emphasis and a differentiated approach, as of course is the case with subject-based learning.

Strategy 6: PC scenario challenges

A ‘PC quiz’ was designed to test students’ knowledge of PCs. Students demonstrated their knowledge of PCs by describing the types of behaviours they commonly associated with them. The two-part quiz aimed to:

- engage students in the self-assessment and target setting of their own development
- test their ability to advise other people about PC development.

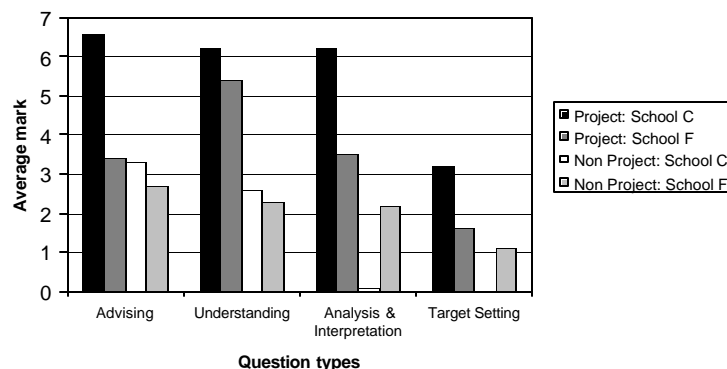
The quizzes focused on five areas of PC-related knowledge:

1. **Self Assessing:** students’ ability to assess their own development
2. **Advising:** students’ ability to advise other people about PC development
3. **Understanding:** students’ understanding of PC terminology
4. **Analysing & Interpreting:** students’ ability to interpret a short scenario in relation to the PCs
5. **Target Setting:** students’ ability to set self-improvement targets.

It was assumed that students with a good understanding of the actions constituting PC improvement, would be ‘more likely’ to display the behaviours. The quizzes aimed to elicit understanding as an indicator of ‘possible’ or ‘likely’ performance. It was appreciated that this form of assessment could not be used as an indicator of ‘actual’ performance, as written or verbal knowledge would not necessarily be transferred into behaviours. However, there can be little doubt that underpinning knowledge, e.g. of roles and responsibilities of teamworking and key practices for good presentations, is critical for being effective in these capabilities.

When compared with control groups it was evident that students involved in the study were better in all areas.

Personal Profiling Summer 2001



TEACHER PROFESSIONAL DEVELOPMENT

Involving practicing teachers in curriculum development, through an action research process, significantly influenced the course and success of the study. Teachers' reflection-on-practice enabled a shared understanding about facilitatory and inhibitory processes and strategies for PC development. There was little, if any, indication that more experienced members of staff were better able to use or to note success with the PC interventions, but there are indications that those who were most successful regularly reflected on their teaching. Teachers who maintained on-going reflection-on-practice, and actively used this to influence classroom activity, typify the stronger case studies.

Success, although more limited in some cases, was influenced by the teachers' ability to mould the interventions to their teaching contexts, and the following quotes indicate the benefit of the flexible, but well-monitored approach, that action-research promoted.

'The research has been mature enough to evolve with respect to comments and evidence from teachers and academic staff. The evolution of the systems and prompts have truly reflected successes and areas for further development over the two years.'

'The research has developed a team of teachers who feel they have ownership of the project. There has been an aspect of professional development through the use of different teaching and learning styles, some 'risk taking' and reflection on teaching, and more particularly in students' learning. It has raised issues re. 'Am I preparing/equipping my students adequately for the world of work with personal and social skills etc.?' Regular meetings of teachers enabled the sharing of information, opinions etc. which the researcher has caused me to reflect on the teaching and learning styles that are used in my own and other peoples' classroom situations. The researchers' work and proactive approach in producing materials for teachers and students has been of benefit. The project has been led by educational imperatives and has changed and developed as it has progressed.'

'There has been an element of professional development for me, in making me reflect on what I do and how I deliver it, and I have enjoyed working with the researcher on the project.'

'My perception about the research is that it has followed its own course and has had to adapt to the different schools and expectations of teachers and students. From my discussions with the researcher and with other colleagues the materials and methodology have had an impact to different extents. In my experience, the research started well but was interrupted by other priorities that arose.'

'I think it's made me more reflective over all. I used to worry enough, now I think I worry even more now.'

Reflective practice is seen as a fundamental requirement of the curriculum development and action research process of developing PCs through the Science curriculum.

Responsiveness to change

The teachers' responsiveness to change influenced the success of the research. For some teachers, the challenges of departmental and management responsibilities were overpowering, and led to their efforts being compromised and often restricted. For others, focused activity was more readily integrated.

A relationship emerged between the level of teachers' activity in the study, their departmental responsibilities, and the impact of the research. Teachers with between one and ten years experience, and with fewer managerial responsibilities, more readily used regular PC interventions. They engaged in a greater degree of in-class trialing than those holding over ten years experience with senior management responsibilities. More experienced teachers seemingly found it more challenging to integrate PC interventions into their regular teaching, and further research would illuminate the underpinning reasons for this. However, it was evident that increased time pressures outside the classroom influenced the extent to which more experienced teachers were able to regularly adopt the research interventions.

Impact

In general, most teachers highlighted the contribution the study had made to their continued professional development. This had stemmed from actively reflecting on practice, students' learning and their being exposed to broader educational issues. They appreciated the training, support and mentoring from the researcher, and the liaison with the wider research group. Many felt that the research had made a permanent impact on their teaching, broadening their understanding of PCs, and focusing their teaching strategies on their development beyond the study classes.

The following quotes illustrate their views on this matter, and provide pertinent examples of the level of impact the experience in action-research had on the teachers.

'For me, the research has made me more aware of my own teaching styles and the need to include a greater variety, but also that it is far more useful to share with the class why you are using a particular strategy and what they should gain from that... I am encouraged by what I have seen, the pupils' response, my own benefits and the possible increase in achievement. I will continue to implement the teaching and learning strategies used, as well as other strategies, regardless of my involvement in the project ending.'

'There have been highs and lows but the experience has made me develop, think and question the nature of the objectives and the strategies I use to create learning opportunities for the students I teach. Using the PCs has created some different perspectives on the learning situation for me and for some of the students particularly from last year's group... There has been an element of professional development for me, in making me reflect on what I do and how I deliver it, and I have enjoyed working with the researcher on the project.'

'The research has reinforced my belief in 'effective learning occurs in an environment of mutual respect, challenge, praise, celebration and fun'. PCs encourage reflective teachers and learners.'

'The study has made 'me more reflective and has led, over 3 months, to the use of more informal teaching styles', it has encouraged more trust and a better rapport with the students... I think it's made me more reflective overall.'

'The research has given me back some confidence that I was losing, along with the battle to make the pupils behave in the way I wanted them to... The presentation of lessons and resources that I have developed would be extremely useful and transferable to other problem classes with behavioural problems.'

The development of reflective practitioners is enhanced through this approach, where facilitation, training, mentoring, and monitoring of activity by the researcher encouraged teachers to think about and influence their practice in the light of the PC interventions. Maintaining a flexible, open-minded and developmental ethos enabled approaches to be tailored to particular environments, responsibilities and students' needs. The effect on teachers' professional development was significant, and benefited from the transferred ownership that the methodology encouraged.

RECOMMENDATIONS

The teachers' role in curriculum development

The findings of this study suggest that teachers can benefit greatly in terms of their professional development when involved in curriculum innovation, although a considerable level of support is required from facilitators. In order for PC development to be integral to curriculum delivery, schools, and ultimately educational policy makers, will need to:

- support and facilitate teachers to engage in the process of action research
- encourage reflective and collaborative partnerships between teachers, researchers and facilitators, so that they realise their personal philosophies, and recognise their influence in the classroom
- influence school culture to encourage curriculum innovation, moving beyond the exploration of statutory components of policy and curriculum
- provide incentives to motivate and encourage teachers to reflect on practice and curriculum delivery, and the influence that contemporary research can have on improvement
- provide relevant, high quality training for teachers in the processes and knowledge associated with curriculum development, reflection and specific areas of interest, i.e. PC development
- monitor the quality of curriculum development, such that interventions are cost and time effective and represent the targeted purposes of development.

The findings also suggest that teachers will need to:

- consider and identify their personal motivations and understandings
- react positively to curriculum innovation, showing willingness to take risks, and trial new approaches
- reflect, independently and with others, on the nature and purpose of their teaching, and its areas for development

- find ways to address government policy whilst also addressing personal/school development interests
- engage in processes of action-research, where possible adopting the role of reflective practitioner

Teacher-researcher collaboration

This study suggests that it is beneficial to have a facilitated process by which teachers and researchers are brought together, to review and reflect on theory and practice. This process encourages shared understandings, resulting in theory-driven and practically-feasible methods. Arriving at a consensus may, however, as shown here, result in a limited or condensed version of theory having direct application to classroom pedagogy. Where this appears to be the case, teachers and researchers benefit from collaboratively considering the purpose and application of the research, and reviewing the utility of its outcomes. Providing opportunities to involve teachers in the developmental process, encouraging them to reflect and raise their understanding of the underpinning concepts, further benefits their sense of ownership and contributes to their professional development.

The PC framework provided a good basis for students' overall development, however further exploration of each capability would be of benefit and enable additional differentiation of approach, and more comprehensive application of capability-specific theory in practice. Dedicating additional time within, or external to the curriculum, benefits teachers through improved opportunities to reflect on theory, its applications to practice, and to overcome possible apprehensions towards their integration.

This study suggests that for educational research to be effective, schools, and ultimately educational policy makers, will need to:

- openly endorse and provide opportunities for teacher-researcher partnerships
- champion and disseminate the findings of educational-based curriculum development.

Teachers will need to:

- find opportunities to engage in, and learn from the trialing of interventions, approaches and strategies aimed at student improvement
- maintain commitment and engagement with curriculum development, overcoming, where possible, curriculum, financial or time constraints
- seek out, consider and establish, links between educational literature in relation to teaching practices
- be willing to persevere with action research, with or without the support and involvement of educational researchers.

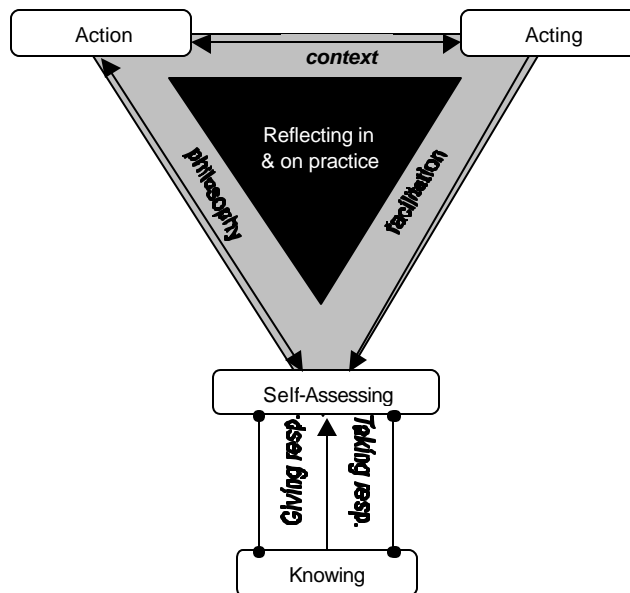
As significantly, researchers will be required to take an active role in:

- forming closer links with teachers to establish stronger links between educational theory and classroom practice
- providing support and working collaboratively to promote the use of educational theory in curriculum development

- being open-minded to change required for theory to be effectively utilised in classroom settings
- assisting teachers in the analysis of findings, facilitating evidence-based outcomes
- addressing issues in educational research, which teachers are concerned about in practice.

The process of PC development

PC development resulted from the interaction of knowledge development, self-assessment, action planning, action and reflection. The findings suggest that the processes are developmental and on-going. Individuals initiating PC development demonstrate behaviours, such as those outlined in the behavioural framework, less frequently, although they may hold the potential to do so. Greater proficiency results from a proactive approach to using knowledge, self-assessments, action plans, and actions, to target and improve PCs. Belief in personal potential is significant in engaging in and facilitating processes of PC development, which rely on the commitment and self-motivation by those involved.



Knowing

Gaining knowledge of the purpose and nature of PCs seems crucial to understanding 'what' and 'why' PCs are being developed. Various strategies were used to teach students about PCs, through their explicit recognition in subject learning, using the behavioural framework, incorporating them into learning outcomes, and developing specific activities for target setting and demonstration. These strategies prompt the questions 'What's this all about?' and 'Does it affect me?', raising awareness and understanding of the meaning and application of PCs in and to everyday contexts.

Knowledge is considered a prerequisite of improvement and it is questionable whether the individuals can effectively undertake processes without sufficient knowledge about PCs, and their relevance to and influence on short-term and longer-term development. Where knowledge gives power to progress, lack of

knowledge may result in either 'doing it, but doing it badly' or 'not doing it at all'. Undertaking PC development with little understanding of its purpose or relevance may result in a highly mechanistic approach, where processes are undertaken with limited learning and personal commitment. In contrast, knowing about PC development encourages individuals to:

- be aware and conscious of improvement
- consider their relevance
- realise development is cyclical and progressive
- be equipped for ongoing commitment through increased engagement.

Self-assessing

Self-assessment encourages students to consider 'What can I do?' and 'What can't I do?', drawing on their improving knowledge of PCs and their related behaviours, to question 'How does what I know of PCs relate to me and my actions?'. This introspective assessment of PCs requires an honest approach, stemming from a commitment to personal improvement. Various strategies were used to encourage this, involving discussion-based activities between peers, parents and teachers, scoring techniques and quizzes. All methods provided indications, and raised awareness of individuals' capabilities, by encouraging consideration of PCs in everyday activity.

Self-assessment is viewed predominantly as a monitoring and learning-tool, as opposed to a summative grading technique. The outcomes of self-assessment are twofold:

1. *Target-setting* - as a stimulus for PC improvement
2. *Evidence-gathering* – as a recording and monitoring strategy enabling the assessment of progress in PC development.

Effective self-assessment presupposes that students are not influenced by what is perceived to be 'good' practice, and do not contrive evidence to suit the assessment. The development of personal profiling tools indicates that student and teacher assessments have high correlation, suggesting that students can provide realistic assessments of themselves. It is important to recognise these issues and to maintain that assessment of PCs remains 'assessment for learning'.

Action planning

Action planning encourages individuals to map out strategies for improvement based on their identified targets, and stimulates questions of 'How can I improve?' and 'Do I have the know-how to change?'. It relies on a basic understanding of methods and strategies to enhance PC development. In some case studies this was assisted by the use of GRASP, and was influenced by the specificity of chosen targets. Individuals benefited from explanation, role-modelling and demonstrations on these occasions, where scenarios illustrated practical actions aimed at improvement.

Ideally, action planning transforms PC targets into practically-orientated strategies to be practised and improved through regular commitment to action. It benefited from reflection, which encouraged plans to directly address what

and how improvement is to take place. If appropriate, action plans may also draw on the expertise and support of others.

This process encouraged a focused approach to considering and identifying methods of improvement, although further insights would be of benefit.

Acting

Action requires individuals to consider, 'Am I doing what I planned to do?' and 'Am I changing my behaviour effectively?'. Action provides a platform to practice, gather evidence and develop PC behaviours, stimulating further improvement through a cyclical process of undertaking, monitoring and control of performance. Learning from action, in this way, is fundamental to improvement. It affects further self-assessments and action plans, and contributes to knowing about development and its integral features.

Taking action relies heavily on personal commitment, and individuals cannot be forced to change. Although facilitation and context play important roles in providing and stimulating opportunities, action relies on individuals' willingness and self-motivation. To some extent this process can be viewed as pivotal to longer-term development, and relies on individuals' personal philosophy and volition.

Reflecting

The processes of knowing, self-assessing, action planning, and acting are influenced by reflection, which informs individuals of their progress, and influences future actions. Reflection in this model provides insights into development, such that individuals engage in a learning process which is relevant and tailored to their needs, understandings and actions. Reflection-in and -on-action are well-recognised features of developmental processes, aimed at promoting and encouraging the role of reflective practitioners (Schon 1983).

Reflection-in-action encouraged individuals to consider 'How am I getting on?', 'What will help me improve now?' or 'How can I help myself now?'. Reflection-in-action related primarily to the 'process' of activity, whilst reflection-on-action focused on the retrospective evaluation of a product or outcome. Reflection-on-action questioned 'How have things gone?' 'Did they go well, and why?', 'How could it have been improved?', 'What have we learnt for next time?'. In this study, reflection-on-action was the main source of evidence. It was facilitated in collaborative settings.

Reflection was influenced by three factors: individuals' philosophy, the context for development and the degree of facilitation provided. Enabling students to take responsibility was a key feature in taking ownership for PC development.

PCs AND THE SCIENCE CURRICULUM

This study has shown that the Science curriculum can provide good opportunities for PC development, although PCs are not considered to be subject-bound. Both subtle and major changes in classroom practice enabled

teachers to explicitly value and regularly highlight strategies for students' PC improvement, however, longer-term integration and change may require more fundamental policy change.

Actively engaging students in learning through the use of practical tasks, project work, group work etc. was found to encourage students to practice and improve targeted areas of PC development. The practical nature of experimental and investigative science encouraged opportunities to develop PCs, such as teamwork, verbal communication, self-management etc. during the course of subject learning. In contrast to didactic teaching styles, these opportunities enabled Science learning to:

- be collaborative between students and the teacher
- be student-centred, focusing on personal and academic needs
- include more hands-on experiences
- promote discussion, target setting and self-assessment of PCs
- refer to more realistic or real-life contexts.

Although teachers experienced the challenges of limited time, heavily prescribed curricula and assessment pressures, their efforts indicated that the integration of PCs through the Science curriculum is feasible, given their motivation and support. Their experiences question the basic structures of the Science NC and the rigidity of its assessment frameworks. Encouragingly, however, recent moves by the QCA to introduce new assessment-for-learning tasks at KS2 and 3 may suggest a willingness to be more flexible.

The prescriptive nature of the Science curriculum concerned teachers, who experienced pressure to fulfil syllabus requirements within specified time frames, resulting in didactic and instructional teaching styles. Teachers who were motivated to consider and revise their teaching styles and to trial research interventions, were successful in targeting and making progress with students' awareness and proficiency in PCs. Active teaching and learning styles were effective in promoting student-centred and collaborative learning opportunities and this was further enhanced and facilitated where teachers received departmental, management or researchers' support.

Teachers considered these changes to not only address PC development, but also to **motivate students towards Science learning**. Teachers described increased engagement with activities, improved classroom relationships, enhanced student commitment to tasks, and improved self-esteem and behaviour. In one school, teachers considered that the approaches contributed to the improvement in Science test scores, whilst others valued the greater opportunity to differentiate Science teaching to students' needs.

Ultimately, schools, departments, teachers and students were clearly aware of, and influenced by, the assessment structures imposed by government policy through national tests. Teaching approaches and departmental targets reflected the assessment-driven culture predominating classroom activity. In spite of teachers' personal or school philosophies endorsing the integration of generic skills and characteristics within the curriculum, assessment

requirements still impacted strongly on teaching and learning in this study. Teachers valued working more flexibly within prescribed schemes of work and programmes of study, viewing the benefits in terms of professional development and student motivation.

The study suggests that PC development would benefit from having equal importance with academic subjects. However, prompting policy change may require a staged process, with the value and influence of PC development is incrementally illustrated through a commitment to curriculum development, and a clear correlation with subject achievement.

It would be useful to encourage policy makers to consider:

- endorsing the value and relevance of PCs within the Science curriculum
- acknowledging the processes and range of beneficial behaviours encompassed by PCs
- suggesting a better balance between the drive for academic standards and the focus on students' PC development
- encouraging further interest in curriculum development which targets the nature and development of PCs within the Science curriculum
- considering the implications of this study in wider subject arenas
- supporting further research into exploring a relationship between PC development and academic achievement.

CONCLUSION

The study's aims were successfully met, gaining an understanding of the teaching of PCs through the Science curriculum. It has offered an innovative approach to the development of PCs, demonstrating teachers' perceptions and experiences, to provide recommendations for pedagogy and practice. The understandings provide strong indications of the processes and strategies by which PC development can effectively be integrated into Science. The findings are not considered to be exhaustive or definitive, however they set foundations for further work.

The ten generic PCs were applied to Science teaching in various ways. Operational definitions and materials to promote reflection and assessment aided their integration into busy classroom environments.

Although teachers' involvement was challenging and time-intensive, it was possible to encourage curriculum change by promoting reflection-in and on-action. Effective teacher-researcher partnerships and the action-research approach exploited opportunities for reflection. Although teachers were initially unquestioning of the underpinning aspects of the research, the collaborative process encouraged the consideration of relevant and pertinent issues.

Teachers benefited from support and training to stimulate change, which engendered an ethos of innovation, autonomy, and professional responsibility. Encouraging teachers' involvement in the differentiation of, and reflection on their teaching proved a significant process, although it required on-going facilitation and support from the researcher.

The transferability and application of this work into wider school settings may be influenced by external factors, such as teacher philosophy, national trends in educational reform, and academic assessment requirements, although these should not be viewed as fundamentally limiting. The enthusiasm of the teachers in this study, driven by their commitment to students' overall development, illustrates how these potential constraints are not insurmountable.

FURTHER STUDY

Throughout the study additional work has been underway, which has illustrated the potential for PC development in wider educational arenas. The use and development of the PC interventions continues in at least three of the schools involved in the study. Where development continues, schools have endeavoured to disseminate the research cross-departmentally. The wider involvement of Local Education Authorities has also been explored.

Primary Education – The Project Programme & Together We Learn

This programme relies on teachers' professional development and reflection, through their involvement in curriculum improvement and innovation for the development of PCs through the subject curriculum. The generic research interventions, emergent strategies and resources were differentiated for use with Year 5 pupils.

Enterprise Education – Lifelong Learning

During the study PCs were also identified as supporting personal development through Enterprise Education schemes. These programmes aim to promote entrepreneurial, enterprise and PC development to improve preparation for the workplace, or as a stimulus for new business opportunities.

Student Personal Capability Index

The assessment and profiling of students' PCs was of particular interest and challenge within the study. Discussions within the research supervisory team led towards the development of a 'Student Personal Capability Index', which, through the use of the PC behavioural framework, forms a diagnostic assessment tool for PC development. It focuses on students' perceptions of the frequency with which they display the PC behaviours, and leads to a profile of student PC behaviour.

STRENGTHS AND LIMITATIONS OF THE STUDY

Key strengths emerge from:

- analysing and gaining understanding from a wide range of data sources, reflecting and interpreting teachers' perceptions and experiences over extended periods of time
- providing the stimulus for teachers to think and reflect on their personal beliefs and pedagogy, and how these were manifest on a day-to-day level
- encouraging collaborative reflection between teachers, the researcher, and university staff, prompting attention from school and departmental management
- involving teachers, from a range of contexts, to commit themselves to exploring new approaches to teaching and learning focused on students' personal development within the context of academic provision

- encouraging a new emphasis within the teaching and learning of Science, such that the impact of teaching was recognised beyond purely students' academic and cognitive development
- influencing attitudinal change at a teacher, classroom, and student level, such that direct impact on students' PC development was noted, catalogued and reviewed
- demonstrating and recording practical strategies for influencing and assessing students' PC development in Science and other subject teaching
- the flexibility of research methodology, encouraging teacher participation and influence on progress
- significantly impacting on teachers' continued professional development.

The findings were strongly influenced by the researcher's personal commitment to the study, which proved to be necessary for sustainability in the majority of schools. Future attempts to replicate or further the study should allow for the perseverance required to coordinate, log and interpret and analyse teachers' perceptions and experiences over time.

The limitations of such a study focus on the:

- diverse and broad PC focus adopted in the research schools, limiting the in-depth understanding of the nature of development in specific PC areas
- range of student groups, thus limiting comparisons between schools
- need for further statistical data to demonstrate the significance of PC development on students' Science academic achievement.

The findings confidently illustrate that the strengths of the study outweigh its limitations, and provide useful indicators for improvement. Although collecting the data for this study was labour intensive, the outcomes enable many other schools to take up this approach with much less staff resource.

FINAL REMARKS

It is the researcher's aim to continue the work in this area, and to consolidate and develop its findings. Sustained efforts to ensure the understanding of PC development continue, with the intention that these might eventually impact on national educational policy reform. Interest in this area is developing, and receives attention from influential organisations, such as the QCA, DFES and DTI, as well as corporate businesses, such as AstraZeneca. Only through the willingness and commitment of teachers, with the support of research and management teams, can insights into classroom practice and innovation be most effectively achieved.

It is hoped that the organisations identified above, and others, continue to facilitate research and development of this type, and value and respond to its outcomes and implications. May such interest continue, so that the concept of schools as places where PC development is explicitly part of the curriculum and classroom activities is more than well-intended rhetoric, and becomes an achievable goal.