**Bringing science to life: the research evidence on the impact of context-based approaches on students’ cognitive and affective responses to science, and what this means for learning environments in school science**

**The purpose of this chapter**

This chapter addresses four important areas in the use and effects of context-based approaches in the teaching of science.  The first part of the chapter considers the nature of context-based approaches. The second part of the chapter draws on a synthesis of a range of research studies to explore the impact of context-based approaches on student’s cognitive and affective responses to science ideas. The third part of the chapter considers some of the issues raised by the review on research into the effects of context-based approaches. Finally, the chapter considers ways in which teachers might be supported and encouraged to make use of such approaches to enhance learning environments in school science.

**Introduction**

Looking back over the last three decades, one of the most discernible trends in science curriculum development in a number of countries has been to use contexts and applications of science as a means of developing scientific understanding. This trend is apparent across the whole age spectrum from primary through to university level, but is most noticeable in materials developed for use in the secondary age range, for students between the ages of 11 and 18. Contexts are selected on the basis of their perceived relevance to students’ immediate and future lives, and include social, economic, environmental, technological and industrial applications of science. Teaching science in this way has come to be known as using a *context-based approach*.

The widespread use of this approach raises a number of questions. What is the appeal of context-based approaches to teachers and others involved in decisions about the use of science curriculum materials? What impact do context-based approaches have on students understanding of science ideas? What impact do context-based approaches have on students’ attitudes to science? What differences are there in the effects on girls and boys, or students of different ability? What impact does following a course that uses context-based approaches have on students’ decisions about studying science subjects beyond the compulsory period?

**What are context-based approaches?**

Gilbert (2006) identified four models for the design of context-based courses: (1) context as the direct application of concepts; (2) context as reciprocity between concepts and applications; (3) context as provided by personal mental activity; (4) context as the social circumstances. The work reviewed in this chapter largely fits into the second of these models, i.e. context as reciprocity between concepts and applications. Gilbert, Bulte and Pilot (2011) describe this model as providing:

 … a situation … selected (by the teacher or course designer) as a vehicle through which key concepts can be taught. The assumption is that there is a cyclical relation between concepts and context throughout the teaching, that is after the concepts are taught, their application in the context is presented, and then a new aspect of the context is focused upon as a prelude to the teaching of new concepts. (p823)

The fundamental principle of such context-based approaches is that contexts and applications of science should be used as the *starting point* for the development of scientific ideas. This contrasts with more conventional or traditional approaches that cover scientific ideas first, before looking at applications. Examples of such context-based approaches include studying medical diagnostic techniques to introduce ideas about electromagnetic radiation and atomic structure, looking at a range of fabrics to introduce ideas about materials and their properties, or looking at the structure of medicinal drugs to introduce ideas about organic chemistry.

*A note on context-based approaches and Science-Technology-Society (STS) approaches*

Context-based approaches have much in common with Science-Technology-Society (STS) approaches, as is evident from the definition of STS approaches provided by Aikenhead (1994). He describes STS approaches as those that emphasise links between science, technology and society by means of emphasising one or more of the following: a technological artefact, process or expertise; the interactions between technology and society; a societal issue related to science or technology; social science content that sheds light on a societal issue related to science and technology; a philosophical, historical, or social issue within the scientific or technological community. The term ‘context-based’ is more common in Europe, whilst ‘STS’ is preferred in North America.

**The aims of context-based approaches**

A number of authors have articulated a range of aims for context-based/STS approaches (e.g. Aikenhead, 1994; Bennett *et al*., 2007; Castano, 2008; Gilbert; 2006; Gilbert, Bulte and Pilot, 2011; Parchman *et al*., 2006; Yager and Weld, 1999). Whilst these may differ in the details, they share in common the notions that context-based approaches have affective, behavioural and cognitive aims, which encompass some or all of the following aspirations:

* to broaden the appeal of science by showing how it relates to people’s lives;
* to show the ways science is used in the world and in the work that scientists do;
* to engage and motivate students in their science lessons;
* to improve attitudes to school science and to science more widely;
* to develop effective understanding of science ideas;
* to increase the numbers studying science subjects beyond the compulsory period;
* to produce scientifically-literate citizens.

*Affective aspirations for context-based approaches*

Arguably, the most significant of the aspirations of context-based approaches lies in the area of students’ *affective* responses to science – how they *feel* about the science they do. Certainly widespread concern in a number of countries has resulted in a considerable amount of research time being devoted to students’ attitudes to science and ways in which they might be addressed. In addition to ‘in-country’ studies, international studies, such as the Relevance of Science Education (ROSE) project (Schreiner, C. and Sjøberg, 2004) and the 2006 Programme for International Student Assessment (PISA) (OECD, 2006) have gathered international data on students’ attitudes to science and students’ engagement in science. Typically, though not exclusively, the majority of the countries that have developed and or adopted context-based approaches are those where there is a concern over students’ affective responses to science, and the hope is that the approaches will motivate students and make them feel more positive about science by helping them see the importance of what they are studying.

*Behavioural aspirations for context-based approaches*

Linked to affective aspirations for context-based approaches is the hope that increased interest on the part of students in science lessons will be translated into a desire to study science subjects beyond the period when they are compulsory. There is longstanding and widespread concern in a number of countries, particularly industrialised countries, over the uptake of science. This concern is also linked to projected shortfalls in the workforce of people with science and science-related qualifications, and one outcome of this has been detailed monitoring in a number of countries of post-compulsory uptake of science subjects (e.g. in Australia: Ainley, Kos and Nicholas, 2008; in Canada: Industry Canada, 2007; in the USA: National Science Foundation, 2010; in Europe: OECD, 2009; in the UK: Roberts, 2002; Sainsbury, 2007; The Royal Society, 2008).

*Cognitive aspirations for context-based approaches*

Context-based approaches have a number of cognitive aspirations for students’ learning: they desire to develop sound understanding of science ideas, to broaden students’ knowledge of how science relates to people’s lives, and how it is used, and the work done by scientists. Such knowledge is essential for the development of scientifically-literate citizens: people who can make sense of some of the many ways that science impinges on their everyday life.

For many involved in the development of context-based materials, there is also the hope that, if students are more interested and motivated by the experiences they are having in their lessons, this increased engagement will result in improved learning of science ideas. However, the effective development of understanding of scientific ideas poses a particular challenge for context-based approaches because of the implications for the way that science ideas are introduced. If ideas are introduced as they arise in particular contexts - in other words, on a ‘need to know’ basis - then it is unlikely that any one concept area will be introduced and developed in full in one particular context, as might be the case in more conventional courses. At best, it could be argued, context-based approach provides opportunities for a ‘drip-feed’ approach, or a form of ‘spiral curriculum’, where ideas introduced in one context can be developed and re-enforced in other contexts, and this would lead to improved understanding. However, there is also the risk that students following context-based courses develop a poorer understanding of science as they are unable to link the ideas they encounter into a coherent picture.

**The impact of context-based approaches on students**

The next section of this chapter focuses on the impact on students of context-based approaches. The evidence presented has been gathered and synthesised using the systematic review methods developed as part of the *Evidence, Policy and Practice Initiative (EPPI),* a UK Government-sponsored project whose aim is to synthesis and disseminate research findings in key areas of education.

*The origins and aims of systematic reviews*

Systematic reviews of research studies are a comparatively recent development in education, though they are well established in medical research. They have emerged from the international debate over the nature and purpose of educational research, and how it contributes to maximising the effectiveness of educational provision (*e.g*. Hargreaves, 1996 and Hillage *et al*., 1998, in the UK; Shavelson and Towne, 2001, in the USA).

There are several reasons why systematic reviews are being seen as a key strand in educational research. Firstly, there is a growing interest in practical policy-related decision making being linked to evidence in a number of areas, not just in education. Systematic reviews of research literature are seen as having the potential to yield evidence on which policy makers can draw. Secondly, there is a drive towards forging closer links between research, policy and practice. In particular, drawing on research findings in classroom practice is seen as desirable, with teachers being encouraged to engage in what is variously described as ‘evidence-based’, ‘evidence-informed’ or ‘evidence-enriched’ practice.

It was for these reasons that, in 2000 the Government in the UK funded, via the Department for Education and Skills (DfES), the Evidence for Policy and Practice Initiative (EPPI)-Centre to focus on systematic reviews of research evidence in key areas of education. The Centre is based in the Social Science Research Unit at the Institute of Education in London and works in partnership with Review Groups located around the UK. The Review Group for Science is located in the Department of Education at the University of York.

*Systematic review methods*

The systemic review process, as developed by the EPPI-Centre, involves several stages: (a) identifying an area for review, and a specifi review question within this; (b) searching for potentially relevant studies; (c) screening studies against agreed criteria to decide which should be included (criteria relate to, for example, aspects such as the age of students, the nature of the research design, and the reported outcomes); (d) coding the studies against specific criteria to build a systematic map of research in the area; (e) extracting the key information from the studies through an in-depth review; and (f) assessing the quality of the evidence generated. A key step in the process, the in-depth review, involves extracting information from studies in a systematic way. This information includes: the aims and rational of the study being reported, the research questions; the design methods, the methods used for data collection and analysis, steps take to maximise the reliability and validity of methods of data collection and analysis, the results and conclusions, the quality of the reporting, and the strength of the evidence presented.

More detail of the review process, together with a critique of the approach, may be found in Bennett *et al*., (2005).

*The scope of the review of the effects of context-based approaches*

The review research question developed for the work discussed in this chapter was: What evidence is there that teaching approaches that emphasise placing science in context and promote links between science, technology and society (STS) improve the understanding of science ideas and the attitudes to science of 11-18-year-old students? The studies included in the review had their principal focus as an evaluation of the effects of context-based approaches on 11-18-year-old students’ understanding of science ideas or attitudes to science as discrete independent variables. The studies were published in English and in the period 1980-2003. (The review was commissioned in 2003 and therefore could not include later studies.) Student age was restricted to 11-18 because the majority of context-based curriculum development projects have been aimed at this age range. The start date for the period of publication was dictated by the fact that the earliest examples of context-based materials date from the beginning of the 1980s.

**Overview of the review findings**

The searches yielded some 2500 studies, of which sixty-one met the inclusion criteria for the review. The chief characteristics of the work are summarised below.

Fifty of the sixty-one studies were carried out in the US, the UK, the Netherlands and Canada. Forty-one studies were undertaken with students in the 11-16 age range, and eighteen with students in the 17-20 age range. The emphasis on students in the 11-16 age range is likely to reflect the perception of this age group being very critical in terms of interest in science declining.

Just over half the studies (35) focused on interventions characterised as ‘science’. Where there was a single-subject focus within this, thirteen related to chemistry, ten to physics and three to biology. It is likely that the focus on chemistry and physics in the individual science disciplines reflects the motives for developing context-based materials in the first instance, with chemistry and physics being seen as subjects with less appeal than biology.

Twenty-four of the sixty-one evaluation studies employed experimental research designs, i.e. data were gathered from a control group experiencing a conventional teaching programme, and an experimental group experiencing the context-based intervention. The remainder explored effects only on students experiencing the context-based materials. Interest in cognitive and affective aspects was roughly equal with, forty-one of the studies reported on aspects of understanding of science ideas and forty-four on attitudes to science. Of these, twenty-four reported on both aspects. Two other aspects that also emerged as featuring prominently in studies were the effects in relation to gender (17 studies) and low ability (7 studies). It was striking that the effects of gender and low ability are explored almost exclusively for the 11-16 age range, where science is mostly taken as a compulsory subject. Twenty-one studies also reported on development of skills. It was decided not to pursue this aspect in any detail in the review because the very wide range of interpretations of the word ‘skills’ would have raised questions over the validity of any synthesis of the evidence.

The most commonly used measure of effect in the experimental studies was, unsurprisingly, pencil-and-paper test results, used in almost two-thirds of the cases. The tests were either tests of understanding of science ideas, or some form of attitude inventory. In a substantial majority of cases, these tests were specifically developed for the evaluation being undertaken, and this points to one of the issues to do with the quality of the evidence, discussed later in the chapter. Questionnaires and interviews featured more prominently in non-experimental studies.

**The detailed review**

As the review focus was on the *impact* of context-based approaches on understanding and attitudes, it was decided to limit the in-depth review to the studies that had employed an experimental design and, within this, to concentrate on the better quality studies. Although the systematic review process is clearly articulated, it is important to appreciate that its application to ‘real’ research studies is not straightforward, and making judgements about the quality of studies is not always easy, particularly when they involve complex interventions such as context-based approaches. Criteria were therefore developed against which studies could be judged. These related to the focus of the study (understanding and/or attitude, with these as explicit independent variables), research design, the reliability and validity of the data collection methods and tools (including the measures to assess understanding and/or attitude, the reliability and validity of data analysis, the sample size and the matching of control and experimental groups, the nature of the data collected (pre and post intervention, or post intervention), the range of outcome measures, and the extent to which the situation in which the data were collected was representative of normal classrooms. Application of these criteria resulted in seventeen of these twenty-four studies being judged to be of suitable quality to include in the in-depth review. The evidence presented below is therefore based on the findings of these seventeen studies.

Table 1 summarises the key features of each of the studies, including the context-based intervention on which the study focused, and the design of the evaluation.

[Table 1 about here.]

Fifteen of the seventeen studies reported evaluations of interventions that took the form of whole courses with a duration of at least one-year, though, within this, five studies focused on a subset of the course as a whole in the evaluation, such a unit on equilibrium, or genetics. The remaining two studies gathered data on enrichment modules, i.e. shorter interventions that were not intended to be whole courses.

With the exception of the studies of three studies, where no details were provided, all the interventions received external funding for their development. In contrast to the funding for the development of the intervention, only five of the evaluation studies received any funding on the basis of information provided in the studies. A pattern of funding being much more strongly tied to the development of the intervention, rather than its evaluation, is very typical of context-based programmes. The funding pattern also often results in evaluations of interventions being carried out by the developers, an issue discussed later in this chapter.

**What impact do context-based approaches have on students’ understanding of science ideas?**

The evidence on understanding of science ideas comes from the findings of twelve studies. Four of the studies indicated that context-based approaches resulted in a better understanding of science ideas than in conventional courses, while seven of the twelve studies indicated that context-based approaches develop a level of scientific understanding comparable to that of conventional courses. Only one study reported poorer understanding as the outcome. Full details of the findings may be found in Bennett *et al.* (2007).

Taken together, these findings do suggest that understanding is not adversely affected by following a context-based approach, and that, in some cases, it might be enhanced. Some of the studies reporting improvements attributed this to the ‘drip feed’ or spiral curriculum approach, though no specific evidence of this link was established (and it would be hard to gather such evidence).

*How large were the changes in understanding?*

If a change is noticed as a result of an education intervention, one question that can be asked is, how large is the change? In the last decade the literature on education evaluation has pointed to the use of measures of ‘effect size’ to quantify the difference in performance between groups, such as a control group and an experimental group receiving an intervention. Effect sizes tend to be described as ‘small’ if less than 0.2, and ‘large’ if greater than 0.4 (see, for example, Cohen, 1969). Typically, educational interventions tend to have small effect sizes.

None of the four studies that reported improved understanding, made references to effect sizes, but two presented their data in sufficient detail for effect sizes to be calculated. Both had effects that would be described as ‘large’ (see above), with one having a particularly large effect. In this latter case, the instrument used to test levels of understanding was developed by the same team who developed the materials, as part of an ongoing research and development programme on STS education, though there was no suggestion at all in the paper that this had inadvertently introduced any bias into the findings. However, it may be the case that the issue concerning style of assessment items mentioned earlier is also having an effect here.

**What impact do context-based approaches have on students’ attitudes to science?**

The evidence on attitudes to school science and to science comes from the findings of nine studies.

The most common approach to gathering data on attitude was the use of inventories involving agreement/disagreement scales (Likert-type questionnaires). In all but one of the cases where these were employed, the instruments were developed by the researchers specifically for the study.

Seven of the nine studies reported evidence that indicates context-based approaches improve attitudes to school science (or aspects of school science) and/or science more generally. Of these studies, three presented data that had been subjected to statistical analysis, and each indicated that the effects were statistically significant at the 0.05 level. In one case, there was sufficient data to calculate an effects size, and this was 0.67 – a large effect. (This evaluation tools use here had been designed by the developers of the intervention.) The remainder of the studies either employed simple descriptive statistics or gathered data for which statistical analysis was not appropriate.

One study reported evidence that indicates context-based approaches promote attitudes to school science comparable to those promoted by conventional courses, and one study reported evidence of a negative effect on attitudes to science.

*Gender effects*

Gender effects were explored in five of the studies. This is unsurprising, given the longstanding concern over the differential involvement of boys and girls in the biological and physical sciences. Three of the studies suggested that gender differences in attitudes are reduced through the use of a context-based approach. Two studies suggested that girls in classes using a context-based approach held more positive attitudes to science than girls in classes using a conventional approach. There was also evidence from one study to suggest girls following context-based courses were more positive than their peers following conventional courses to pursuing careers involving science, with results being significant at the 0.01 level. Taken together, these findings suggest that there is moderate evidence to indicate that context-based/STS approaches promote more positive attitudes to science in both girls and boys, and reduce the gender differences in attitudes.

*Post-compulsory uptake of science subjects*

Only three of the studies collected data relating to student’s plans for studying science beyond the compulsory period, and students’ career intentions. This is, perhaps, rather surprising, for two reasons. First, students’ views in these areas are seen as important indicators of attitudes to science. Second, a desire to increase numbers in post-compulsory study with a view to pursuing careers in science-related jobs is one of the aims that underpins many of context-based courses. The evidence reported is mixed, with two studies reporting increases in numbers electing to study science subjects and one reporting no change. It is worth noting that one feature which distinguishes the studies reporting increased uptake from that reporting no change is that, in the latter case, the author was not the teacher of the students from whom the data were collected. This points to individual teacher effects exerting a strong influence on students.

Overall, the review findings on attitudes to school science and science appear to provide strong evidence that context-based approaches foster more positive attitudes to school science than conventional courses. There is more limited evidence to suggest context-based approaches foster more positive attitudes to science more generally than conventional courses, and mixed (and limited) evidence on the impact of context-based approaches on science subject choices in the post-compulsory period.

Full details of the findings may be found in Bennett *et al.* (2007).

**Issues in research into the effects of context-based approaches**

Synthesising the evidence on the effects of teachers using context-based approaches raises a number of issues about research in the area, and the strength of the evidence base generated.

*The nature of the resources*

The information in the study reports included in the review focused on the evaluation data, and very few, if any, examples of the resources were included. It is clear from the study reports that the terms ‘context-based approaches’ (and ‘STS approaches’) can be interpreted quite broadly. Examination of the intervention resources which were available showed the use of contexts that were relevant to students’ lives and interests at present or in the future, related to technological developments and artefacts likely to be of interest to students, and were relevant to students’ possible future careers. At more advanced levels of study, there were also links to recent scientific research and innovations, to the work of scientists, and to industry. This diversity of contexts suggests that some caution is needed in interpreting the findings of this review, as it is difficult to imagine that all contexts have the same effects on all students. However, this caveat can be set against a background of the consistency of the evidence yielded by the studies taken as a whole.

*Evaluation designs*

This paper has focused on evaluations with experimental designs, and it is interesting to note that only twenty-four of the sixty-one studies identified adopted some form of experimental design. The political climate over the last decade has been one in which the education research community has been urged to make more use of experimental designs to generate solid evidence to inform policy decisions (see, for example, Hargreaves, 1996; Oakley, 2000; Torgerson and Torgerson, 2001).

However, there are practical constraints which may contribute to experimental designs being less feasible in educational contexts, particularly in relation to the evaluation of large-scale curriculum interventions. Decisions on participation in such interventions can rarely be made by researchers, and this means that it is very difficult to allocate students or classes randomly to groups that will or will not receive an intervention. Most often, the research design has to be built around existing class sets in schools. In the studies in this review, the sampling very often had an opportunistic dimension in that schools and classes using a new intervention were identified, and then other schools using more conventional course were identified to create a comparison group of roughly similar size. Practical constraints also frequently make it necessary to gather data from intact classes, and this raises issues to do with the construction of matched samples for control and experiential groups.

*Who collects the data and why?*

Two of the features noted when summarising the studies for the review were the relationship of the study author(s) to the interventions being evaluated and the purposes for which the data were being collected. It was very noticeable that this information was often difficult to identify in the study reports and, in almost all cases, had to be drawn by inference. In the majority of cases, the researchers were either involved in the development of the intervention or users of the intervention. The authors of three of the studies collected their data for personal interest as part of their studies for a higher degree. Nine of the studies appeared to have been undertaken by people who also had a significant involvement in the development of the materials. The involvement of the developers in the evaluation does raise ethical issues about introducing possible bias into the evaluation findings, as it could be argued that developers have a vested interest in demonstrating their intervention has been successful. However, the studies included in this review did appear to take steps to minimise such bias.

*Standardisation of instruments*

The studies employed a variety of instruments to gather data on both understanding and attitudes. In almost every case, new instruments were developed, though some drew on other instruments. This variety means it is difficult to make direct comparisons between studies or undertake meta-analysis of data. It is interesting to consider why research in the area has this characteristic. Certainly the would be some merit in a greater degree of consistency in the instruments used, which could, depending on the outcomes, strengthen claims made about the findings. However, the work is also characterised by its international dimensions, and, as international studies such as the PISA study have demonstrated (OECD, 2007), there are considerable challenges in developing instruments for use in a number of countries, where it is likely that there will be different educational frameworks and curricula. Such factors militate against the validity of using some form of cross-national instruments, though there would appear to be scope for more widespread use of standard diagnostic questions to assess understanding of topics.

*Measuring understanding*

The measurement of understanding in relation to context-based and conventional approaches does raise a particular issue about the nature of the items used, which can be illustrated by the findings on of one of the studies undertaken in England. Here, students take an external examination at age 18+ (Advanced-level). Several examination options are available, including one assessing a context-based course. The overall standard of all these final examinations is regulated by an external body, which specifies content to be covered, which is common to all the examinations. However, at the time the study was undertaken, there was a considerable degree of latitude permitted in the choice of teaching approaches and the style of examination questions. This meant that students could follow a context-based course which was also assessed through context-led questions, rather than the more conventional examination questions. In addition to external examinations at age 18+, the Royal Society of Chemistry (a prestigious scientific body) has developed over some years a test bank of standard chemistry questions which it makes available to teachers to use if they so wish to assess their students’ knowledge. The study reported that students taking a context-based chemistry course got lower scores on the Royal Society of Chemistry test than students taking a conventional course. However, when the same groups of students took their final examinations, the students following the context-based course did better than students taking the conventional course. One of the other studies reports a similar finding when different styles of assessment questions were used. The implication is that students on different types of courses are likely to perform better on assessment items that resemble the style of course they are following.

**Implications for teachers and teaching**

For some teachers, the appeal of a context-based approach is ‘obvious’. It maps on to their pedagogic content knowledge in that it formalises what they already know from experience: if you want to engage a class of students, you have to capture their interest with something to which they can relate. Thus some teachers, when they hear about context-based approaches for the first time, identify with the underlying philosophy, and they can they can see it working in their lessons because it draws on what they already do, albeit in a more structured and explicit way. This match can be termed ‘value congruence’ (Harland and Kinder, 1997). Such teachers will not be difficult to persuade to try context-based approaches in their teaching.

For other teachers, it may be that ‘harder’ evidence is needed, and the review findings reported in this chapter may persuade teachers that there is a sound evidence base pointing to a number of benefits of a context-based approach over a more conventional approach. In particular, the majority of students report that they enjoy their science lessons more, students understand the science they do at least as well as they would on conventional courses, and that some students feel more positively disposed towards science. Such evidence can be presented to teachers by those developing context-based resources.

However, whilst value congruence and research evidence may persuade some teachers to adopt context-based approaches, most will need additional help and support. Teaching science in context requires a departure from traditional teacher-driven learning to a style incorporating more learner-centred activity (Cho, 2002; Lubben, Bennett, Hogarth and Robinson, 2002). Analysis of a range of resources developed to support context-based approaches (e.g. Salters suite of courses in the UK, the ‘im Kontext’ suite of programmes in Germany) shows that they typically employ a wider range of teaching strategies (e.g. small-group discussions, role-play, student presentations) than is normally associated with conventional science courses. As Parchmann and Luecken (2010) note, this can be challenging for teachers, as they are likely to feel less comfortable with such teaching strategies, particularly when they are encountered for the first time.

Thus a particularly important aspect of context-based approaches is that resources are produced in a form that makes them easy for teachers to see what the approach means in practice, and provides concrete guidance on how the resources should be used. A characteristic of the most successful and enduring context-based programmes is that the task of translating principles into practice has been done for teachers through the development of student worksheets and other student resources. This provides teachers with the crucial support they need to give them the confidence to try out different activities in the classroom, and is also likely to contribute to the development of ‘value congruence’. Incorporating non-threatening opportunities to practice the use of such materials into professional development courses is also likely to help teachers develop their confidence. Producing material is a form that is ready for use in the classroom also goes a considerable way to addressing a problem well-articulated by Black and Wiliam (1998) when considering the matter of what makes teachers change their approaches:

Teachers will not take up attractive-sounding ideas, albeit based on extensive research, if these are presented as general principles which leave entirely to them the task of translating them into everyday practice - their classroom lives are too busy … for this to be possible … What they need is a variety of living examples of implementation, by teachers with whom they can identify, and from whom they can derive both the conviction and confidence that they can do better, and see concrete examples of what doing better means in practice. (p10)

**Conclusions**

This chapter has considered the nature of context-based approaches, and presented the findings of a research synthesis on their impact on students’ cognitive and affective responses to science teaching. The synthesis suggest that studies of the effects of context-based approaches do yield a body of evidence to support claims that such approaches have a positive impact on students’ attitudes to their science lessons, and that students learning of science concepts is comparable with that of more conventional approaches. The review does, however, point to a number of issues to do with evaluating the effectiveness of context-based approaches, relating both to interpretation of the term, research approaches adopted and instruments used to assess attitudes to science and understanding of science lessons. The chapter has also examined implications of the review for teachers and those developing context-based approaches, identifying ‘value congruence’, the existence of an evidence base on effects of use, and the provision of resources that translate aspirations into practical resources for use in the classroom as key features likely to influence teachers’ decisions to engage with the use of context-based approaches.

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(\* = studies used in research synthesis)

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**Keywords**

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**Biographical information**

Judith Bennett is a professor of education and Head of the Department of Education at the University of York in the UK. Her principal research interests focus on the exploration of students’ attitudes to science and ways in which they might be improved, and the evaluation of educational interventions.