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1 **Why use a cross-curricular approach to teaching and learning?**

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In this chapter we will look at the broader debate surrounding cross-curricular approaches to teaching and learning. We will look at some links to learning theories that have influenced this approach as well as considering some of the practicalities of using a cross-curricular approach when teaching science in primary schools.

A brief history

The merits of cross-curricular or thematic work in the primary curriculum have been the subject of debate for some considerable time, and have tended to be characterized in the press as a debate about the merits of 'progressive' or 'child-centred' forms of teaching as compared to 'traditional' teaching, in which subjects are taught discretely. Put simply, the emphasis in 'progressive' or 'child-centred' approaches is on helping children to make sense of the world in which they live, whereas 'traditional' approaches tend to place an emphasis on essential knowledge that children need to learn.

Historically, cross-curricular work has been associated with more child-centred, constructivist approaches to primary education, which in the last century was endorsed by the Hadow Report of 1931, the Plowden Report of 1967 and a number of School Council publications in the 1970s. Arguments in support of this approach are based in an understanding of child development. Very young children, at preschool and the lower end of primary school, do not assign particular activities to a particular subject, and therefore this approach more closely mirrors the way they learn. The assertion in the Plowden Report (CACE, 1967: para 555) that 'children's learning does not fit into neat subject categories' is frequently used to support cross-curricular themes or topics although the report did recognize

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that some discrete subject teaching will be relevant for older primary children. More recently, this view of children's learning moving from broad areas of learning to more discrete subject teaching formed the basis of the primary curriculum proposed by the Independent Review of the Primary Curriculum, commissioned by the last Labour Government (Rose, 2009). According to Carr (2007), this approach is also based on the work of John Dewey, who argued that much knowledge is interrelated. For example, knowledge of the properties of materials combined with knowledge about the climate of different regions of the world helps children to understand differences in the styles of buildings in different regions of the world.

Task 1.1

Choose a common building material such as a brick, concrete or timber.

What are the properties of that material that make it suitable for building with? Think about the strength of the material, whether it is waterproof, how well it will weather, the price and availability.

Find photographs of houses from different regions of the world made from that material. Note the differences in the styles of the buildings. How has the climate influenced the style of building and the choice of materials used?

Look at different houses in your local area and develop a timeline for when they were built. Choose one part of a house, such as the roof or windows. Is the same building material used throughout the timeline?

The 1960s, 1970s and early 1980s saw a move towards organizing the curriculum in primary schools around cross-curricular topics or projects (Carr, 2007), though not to the exclusion of discrete subject teaching, particularly of mathematics and English (Alexander et al., 1992). However, the introduction of the National Curriculum (DfEE/QCA, 1999), with its focus on programmes of study for individual subjects, resulted in a move towards discrete subject teaching in primary schools. This greater emphasis on teaching discrete subjects was further encouraged by successive governments following the 'Three Wise Men' report by Alexander, Rose and Woodhead (1992) which criticized poorly planned topic or thematic work in primary schools that resulted in superficial learning. The fact that this report acknowledged that, when well planned, topic work produced work of a high standard tended to be overlooked.

Although discrete subject teaching became more broadly accepted in primary schools, a ten-year study by Boyle and Bragg (2008) between 1997

and 2007 showed that subjects continued to be taught in a cross-curricular way at least for some of the time, throughout this period. They found that the trend for discrete subject teaching reached a peak following the introduction of the Numeracy and Literacy Strategies and QCA schemes of work, when most subjects were taught as discrete subjects for more than 50 per cent of the time for which they were taught. The study found that from 2002 schools began to reintroduce cross-curricular teaching, often for the pragmatic reason that it enabled them to meet the expectation in the National Curriculum that all children are entitled to a 'coherent, broad and balanced curriculum' (DfEE/QCA, 1999: 4). This trend also coincided with a recognition by Ofsted (2002) that thematic or cross-curricular teaching was a feature of successful primary schools, and at the same time guidance on adopting a more flexible approach to the curriculum, *Designing and Timetabling the Primary Curriculum*, was published (QCA, 2002). More recently, the notion that discrete subject teaching and cross-curricular teaching are mutually exclusive has been challenged by both Alexander (2010: 245–7) and Rose (2009), who advocate a combination of discrete subject teaching and of well planned cross-curricular themes.

Our primary schools also show that high standards are best secured when essential knowledge and skills are learned both through direct, high-quality subject teaching and also through this content being applied and used in cross-curricular studies.

(Rose, 2009: 2)

Alexander (2010) argues that when planning a curriculum it is important to develop a common understanding of how knowledge is developed. He contends that learning how knowledge is evaluated and tested can be just as relevant to subject disciplines as to interdisciplinary topics. This move towards including cross-curricular approaches in the curriculum can also be seen in the curricula of a number of different countries, for example the Curriculum for Excellence in Scotland (2008), Northern Ireland (2005), and New Zealand (2007). In this chapter we will consider reasons for adopting a cross-curricular approach to teaching and learning and some of the challenges this approach presents.

First, though, we need to consider different interpretations of the term 'cross-curricular teaching and learning', because over the years a variety of different terms have been used in connection with this approach. For example, cross-curricular work has been called 'project work' or 'project-based learning', 'topic' or 'thematic work', 'integrated learning' and 'interdisciplinary learning' (Carr, 2007; Czerniak, 2007). In this book we are primarily concerned with considering how another subject can support and enhance children's learning in science. This may be because the

knowledge and understanding learned in that subject complements a particular science topic, or because there are skills common to both subjects. It is not our intention to suggest that cross-curricular study should be limited to making links between two subjects, but we note that a number of recent reports about cross-curricular work emphasize the importance of limiting the number of subjects which contribute to a given theme or topic to ensure that there is a clear focus for children's learning (Ofsted, 2002; Jarvis, 2009; Barnes, 2011: 181–98). Instead, our intention is to consider how individual subjects both enhance and are enhanced by making effective cross-curricular links with science.

Why use a cross-curricular approach in science?

When deciding on which teaching strategy is most appropriate to use in a particular context it is important to consider the view of learning that informs your choice. Both science education and cross-curricular approaches to teaching and learning are informed by a constructivist view of learning. This is based on the proposition that learning is an active mental process in which connections are made between experience, prior knowledge and new ideas, to develop and refine children's knowledge and understanding of a subject or topic. It also emphasizes that the learner is in control of their learning (Pritchard, 2005: 41). In science this view of learning is supported by more than 30 years of research, for example the Children's Learning in Science Project (1984–86) and the SPACE Project (1990–95) (Wellcome Trust, 2005), which show that learning in science is most effective when children are able to see the relevance of the science they are learning and when it is meaningful to them. Making science interesting and relevant to children is one of the key features of effective science teaching and learning (Harlen, 2006: 9; Wellcome Trust, 2008), and developing effective cross-curricular links helps children to appreciate the relevance of scientific ideas and skills (Jarvis, 2009). Schools may also have a more pragmatic reason for developing cross-curricular links, as Boyle and Bragg (2008) discovered. They found that developing cross-curricular links enabled the schools to develop a broad and balanced curriculum, although Alexander (2010: 260) cautions against using manageability of the curriculum as a reason for making links between different areas of the curriculum.

Concerns about cross-curricular work

When discussing a cross-curricular approach to teaching and learning it is important to keep in mind the concerns that have been raised by critics

of this approach. These are that:

- it lacks rigour and pupils may not develop essential subject-specific skills (Muijs and Reynolds, 2011)
- subjects lose their identity (Czerniak, 2007; Parkinson, 2010; Barnes, 2011).
- learning is superficial and fragmentary (Alexander et al., 1992)
- tenuous links are made between subjects (Jarvis, 2009; Laurie, 2011: 128).

What has given rise to these concerns? Given that one of the advantages of cross-curricular work is that children are able to apply skills developed in one subject to other subjects, why is there concern that children may not develop subject-specific skills? Is this due to poor planning or might this be caused by limited opportunities to develop knowledge and understanding of these subject-specific skills? Is the concern about superficial and fragmentary learning in topics due to teachers being overambitious when planning topics, and making links between too many subject areas given the timescale available for the work? Is it, as Thomas (2012) suggests, because teachers have not been encouraged to be curriculum developers? Recently concern has been raised over the quality of teaching of foundation subjects in the primary curriculum (Alexander, 2010: 244–5) due to the emphasis on literacy and numeracy, both in primary schools and in professional development courses for primary teachers. The concern about superficial and fragmentary teaching may then not be specific to cross-curricular or topic work, but relate to the status of a subject within the curriculum. Do subjects lose their identity in cross-curricular projects because when planning a topic the focus has been on the product rather than the process of learning and the unique contribution of each subject to that learning?

Advantages of cross-curricular work

Ofsted (2002) noted that one of the features of successful primary schools is the ability of teachers to plan opportunities for children to apply the knowledge and skills learned in one subject to other subjects. This leads me to ask, 'What is it that makes cross-curricular work a successful approach for teaching and learning?' As has already been suggested, cross-curricular teaching and learning has strong links with the constructivist view of learning, as children work collaboratively and learn from their own direct experience (Hayes, 2010). Adopting a cross-curricular approach to teaching and learning requires careful consideration of what we mean when

we talk about 'knowledge'. Is it possible to develop a good understanding of any given event or idea by simply being able to quote relevant facts or information? Alexander (2010: 248) points out that learning facts or information is not the same as developing knowledge. Kerry (2011), who is a strong advocate for cross-curricular work, argues that individual subject disciplines only give a partial insight into a particular topic or problem, and that to enable them to fully understand the problem, children need to be encouraged to draw together insights from different subjects. This notion that knowledge is interrelated is supported by Carr (2007), who traced it back to Dewey's views that knowledge is useful to help develop an understanding of our experiences rather than simply learning reported facts or information.

Well planned cross-curricular work helps children make sense of their learning because knowledge and skills learned in one subject are used to reinforce and support learning in other subjects (Hayes, 2010). Consider, for example, teaching children about measurement in mathematics. In which other subjects will children use this knowledge and develop their ability to make accurate measurements? How does making accurate measurements when cooking or when making an artefact in design and technology help develop children's competence with the concept of measurement in mathematics? Barnes (2011) and Savage (2011), though, point out that to be effective the links between subjects need to be made explicit, because it should not be assumed that skills and knowledge learned in one context will be transferred to a different context (Pritchard, 2005: 88). This is not a simple matter because it requires teachers to have good knowledge of a range of different subjects, which includes being sensitive to the culture or values of a subject as well as the concepts, knowledge and skills inherent in that subject (Savage, 2011: 40). A recurring theme in the case studies and reports about cross-curricular work (Ofsted, 2008; Barnes, 2011; Laurie, 2011) is the need to ensure that links between subjects are authentic, because if a subject does not fit logically into the theme or topic the skills and concepts of that subject may not be adequately addressed (Jarvis, 2009; Muijs and Reynolds, 2011), compromising learning in the subject.

Although Venville et al. (2002), while acknowledging the concerns of subject specialists that children's understanding of subject-specific knowledge was less secure when they were working on a cross-curricular project, suggest that this may be balanced by an improvement in other aspects of learning, such as developing research and problem-solving skills. Kerry (2011: 20–35) also argues that cross-curricular work helps children develop thinking skills such as problem-solving and reasoning, a view supported by Barnes (2011), because children not only apply knowledge and skills learned in one subject to another, but will also synthesize information and ideas from a range of sources. Learning to make links is one of the attributes

of a good learner (Claxton, 2002: 27). Also relevant to this discussion is the notion that in real life insights from different subject disciplines are used to solve problems (Muijs and Reynolds, 2011: 282) and so giving children opportunities to work on cross-curricular topics develops skills that will be useful in their future careers.

One of the features of a constructivist view of learning, based on the work of both Bruner and Vygotsky, is that learning is a collaborative process both between children and between children and their teacher. Consequently language has a central role in developing thinking and learning (Mercer, 2000; Alexander, 2008). As with all teaching, when planning cross-curricular work we need to be aware of how language will support children's learning. This is discussed in more detail in Chapter 2. All subjects have their own particular language culture, and Savage (2011: 99) highlights the importance of ensuring consistency in the use of language in cross-curricular study while at the same time ensuring that the technical language of the discrete subjects is used accurately. However, for children, one of the benefits of cross-curricular work is that the language demands are related (Jarvis, 2009), which is an advantage in communities where English is not their mother tongue.

A common theme in much of the recent literature about cross-curricular work is that it improves pupils' motivation and engagement, as learning is placed in a context that is both interesting and relevant to the learner (QCA, 2005; Barnes, 2011; Muijs and Reynolds, 2011: 282; Savage, 2011). Some, though, would question whether it is possible for all children to be interested and motivated by any one theme or topic. Perhaps one reason that cross-curricular work improves motivation and engagement is the breadth of study. For some children it will be the science that interests them, whereas for others it will be another subject such as geography, history or art. Fifty years on, I can still remember learning about chocolate at primary school. I was fascinated to learn about the Aztec rituals related to drinking chocolate and how the Conquistadors introduced chocolate to Europe, as well as learning about the changes to chocolate as it was processed. Rennie et al. (2011) found that when children worked on a cross-curricular project, the motivation for learning was mastering a task or solving a problem rather than gaining a good grade in a test or exam. Another reason that cross-curricular work is motivating is that it allows for more independent, learner-led exploration of the topic (Muijs and Reynolds, 2011). This appeal to the emotional aspects of learning resonates with a growing understanding of how emotions affect learning. Many readers will recognize that they are much more prepared to make the effort to learn something that is thought to be 'difficult' when they are interested in the topic, and it is more difficult to learn when they are not interested or do not see the point of learning something. Many will also recognize

the 'buzz' they get when the children in their class are engaged and show interest and enthusiasm for a particular lesson or topic, whether this is in a discrete subject or as part of a cross-curricular topic. Curran (2008: 61–6), writing about how the brain 'works', states that 'learning is directed and controlled by the emotional / limbic brain' and 'the emotional self is centrally involved in the vast majority of things you learn'. It should be noted, however, that all teaching, whether of discrete subjects or of cross-curricular topics, should endeavour to make learning 'feel good'. The benefits for children's personal and social development of working on cross-curricular projects were also noted by Ofsted (2008) in a survey of schools which had adopted a cross-curricular or thematic approach to the curriculum.

Challenges when developing cross-curricular work

Having considered some of the benefits of using a cross-curricular approach to enhance children's learning, we also recognize that there are challenges. Several reports make the point that developing cross-curricular work requires carefully designed professional development for teachers, and time needs to be allocated for this (Ofsted, 2008; Jarvis, 2009; Thomas, 2012). This need for professional development, as the report from the Royal Society for the Arts (RSA) points out (Thomas, 2012), arises because many teachers have received little or no training in designing the curriculum for their school because of the emphasis, since the introduction of the National Curriculum, on discrete subject teaching and, particularly in primary schools, the reliance on detailed schemes of work. As a consequence, many of the newer entrants to the teaching profession have had limited experience of cross-curricular work, either as pupils or subsequently during their school-based training (Barnes and Shirley, 2007; Aston and Jackson, 2010), and as a result tend to compartmentalize learning. The need for primary teachers to develop an understanding of the holistic nature of the primary curriculum during initial teacher education is highlighted by Alexander (2010: 424). Although the professional development that is needed to support curriculum developments may come from outside agencies (Thomas, 2012), schools that have successfully introduced thematic or cross-curricular work have done so using the expertise of the teachers in their school (Ofsted, 2008).

One of the challenges when planning cross-curricular work is maintaining an appropriate balance between the subjects which contribute to the study, so having a clear rationale for including subjects in the theme or topic helps to maintain the rigour of the study. Jarvis (2009) notes that there is a risk that one subject may have a higher profile because the

enthusiasm of the pupils drives the learning in one particular direction. However, Laurie (2011) notes that for some topics it may be appropriate to have a lead subject which drives the particular study, while Barnes (2011) recommends keeping to a maximum of three or four subjects which contribute to a cross-curricular theme or study to maintain the integrity of the study. At the risk of stating the obvious, developing clear learning objectives also helps establish cross-curricular links that focus on the learning not simply the activity or product (Savage, 2011: 61). Studies have also shown that using the National Curriculum programmes of study to inform the planning of cross-curricular work is a successful strategy to help ensure an appropriate balance (Ofsted, 2008; Jarvis, 2009). An advantage of this is that it may help to address the concerns about a lack of progression in children's learning which were raised about 'topic work' in the 'Three Wise Men' report (Alexander et al., 1992: paras 67–8). We will discuss planning in greater detail in Chapter 10.

A second challenge when developing cross-curricular work relates to time. Time needs to be allocated in three different aspects of cross-curricular work. In the first instance, when planning a cross-curricular theme or topic teachers need time to research it and to explore the links between the different subjects. Savage (2011) talks about teachers needing a deep understanding of the culture of each subject, by which he means not only what is learned but also how it is taught/learned, and how it affects the lives of both the teacher and the pupil. For example, we have already hinted at the need to consider the language demands of different subjects. Planning also takes longer, especially when the topic is new, because the resources – both physical resources and human resources – may not be established in the school. It is an opportunity to explore and develop relationships with organizations or individuals who can support children's learning. For example there are many in the 'older generation' who can give first-hand accounts of their life in the Second World War. The second consideration about time is classroom-based, and focuses on managing the timetable flexibly to enable children to become engaged, and hopefully engrossed, in the topic. There may be a need at one point for an intense focus, such as a whole day, on the topic, while at a different stage it may be more appropriate to focus for an hour or two on one particular aspect. Finally it is important to allow time for an evaluation of the topic from both the children's perspective and the teacher's perspective.

Assessment is a further challenge for teachers developing a cross-curricular approach. Both Ofsted (2008) and Kerry (2011: 12) assert that well planned cross-curricular work can have a positive impact on achievements, which is evidenced through tests and external exams. However studies by both Venville et al. (2002) and Rennie et al. (2011) discuss the difficulty of assessing children's learning when using a cross-curricular

approach. They point out that traditional forms of assessment are limited because they tend to focus on assessing subject-specific knowledge and concepts and do not take account of how children apply subject-specific knowledge. However, this should not be an excuse for not assessing children's learning. As much of the literature on assessment for learning notes, an important feature of any assessment is being able to clearly identify the learning intentions at any stage of a topic. Although it is an obvious statement to make, turning this into the reality that informs effective teaching and learning requires a good understanding of the skills and knowledge that will be developed and applied in any given topic. This is discussed in more detail in Chapter 11.

Conclusion

This chapter has given a very brief history of cross-curricular approaches to teaching and learning in primary education, and considered how constructivist learning theories support this approach and consequently are closely allied to the research into effective science education. It has recognized that there are challenges for teachers when adopting a cross-curricular approach and that there is no clear message as to how to achieve effective cross-curricular learning. Decisions about when and how to make links between subjects will depend on the educational purpose for adopting this approach.

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