Should we be using learning styles?

What research has to say to practice

learning &skills research centre

Learning style instruments are widely used. But are they reliable and valid? Do they have an impact on pedagogy? This report examines 13 models of learning style and concludes that it matters fundamentally which model is chosen. Positive recommendations are made for students, teachers and trainers, managers, researchers and inspectors.

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LSRC reference

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What research has to say to practice

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Foreword

The theory and practice of learning styles has generated great interest and controversy over the past 20 years and more. The Learning and Skills Research Centre would like to express its appreciation to the authors of two complementary reports, for the time and effort that went into their production and for providing a valuable resource for researchers and practitioners in the learning and skills sector.

These reports serve two key purposes: first, they contribute to what we know about models of learning styles and to our knowledge of what these offer to teachers and learners. Second, the reports identify an agenda for further research: to evaluate rigorously key models in a variety of learning environments in order to better understand their merits and deficiencies. We publish these reports in the spirit of stimulating debate and enabling knowledge of learning styles to be developed for the benefit of practice and policy.

The complementary report *Learning styles and pedagogy in post-16 learning* provides a systematic and critical review of learning styles models. Final sections are common to both reports: these draw out the implications for pedagogy and offer recommendations and conclusions for practitioners, policy-makers and the research community.

LSDA would also like to thank the steering committee for incisive commentary and support throughout the project.

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Section 1

The appeal of learning styles

Learning styles in practice – i

Megan is a communications lecturer in a further education (FE) college, studying for a BA in Post-16 Education. She was inspired by some sessions on learning styles during the course to make this the focus of her action research project. She administers a well-known learning styles ***inventory***[1] to a group of mixed-age students who are following a communications and study skills module as part of an Access course for entry to higher education. She makes it clear to the students that this is part of a research project for her degree. She aims to diagnose their learning styles at the outset of the course and again at the end, and then to change her teaching and assessment activities so that students develop all four learning styles as the course progresses.

Megan collects the questionnaire responses, analyses them, and then goes back to the group the following week with the results. The members of the group spend some time deciding what their strengths and weaknesses are on the four learning styles, and what activities might make them into rounded learners. Following this discussion, she asks each student to make a plan for developing his or her learning styles. She also considers what she will have to do to deal with all four types of style during the year she teaches the students.

Given that she only sees the students for 2 hours each week, it is not possible to spend time with them individually in order to review their progress in depth. However, she changes three aspects of her practice. First, she aims to cover all four styles in the way she teaches the class, and to evaluate the effects with them informally in a group review after each new activity. Second, she asks them to work in small groups for a whole lesson at three different points in the year, to review their initial ***diagnosis*** and see what they still need to attend to in order to enhance their learning styles. And finally, she tries to alter the tone and focus of her written comments on their assignments to encourage other learning styles. So, for example, she adds comments designed to encourage more practically oriented students to be more abstract and to engage with concepts, or to reflect more on their work.

The action research project and its open-ended, negotiated approach to using the inventory appear to have an effect on most of the students' motivation and attitude to their assignments. Megan cannot know, without a control group, whether trying to encourage all four learning styles has raised achievement, but she feels that the project has given her and her students new enthusiasm.

Finally, Megan passes her degree. Her team manager is very interested in her research and asks her to run some staff development sessions on learning styles for other curriculum teams. Following these, the college applies to the Learning and Skills Research Network (LSRN) for funds to enable other staff to carry out similar action research.

This vignette of Megan's use of learning styles, based on the professional practice of a lecturer in an FE college, may be considered an example of 'good practice'. But what exactly is the status of the learning styles inventory she is using? For example, is it reliable – that is to say, does it measure the learning styles of students consistently? Is it valid – is it really a test of learning styles or of some other quality such as intelligence or personality? How should tutors and managers be responding to the learning styles of their students or staff?

How can we teach students if we do not know how they learn? How can we improve the performance of our employees if we do not know how we ourselves learn or how to enhance their learning? Are the learning difficulties of so many students/employees better understood as the teaching problems of tutors/managers? How can we pretend any longer that we are serious about creating a learning society if we have no satisfactory response to the questions: what model of learning do you operate with, and how do you use it to improve your practice and that of your students/staff/organisation? These are just some of the issues raised by those researchers who for the last 40–50 years have been studying the learning styles of individuals.

The mainstream appeal of learning styles

Just common sense?

The example we began with, of learning styles in everyday use, shows the appeal of the idea that teachers and course designers should pay closer attention to students' learning styles: by diagnosing them, by encouraging students to reflect on them and by designing teaching and learning interventions around them. A further impetus to interest in post-16 learning styles is given by a government policy that aims to develop the necessary attitudes and skills for lifelong learning, particularly in relation to 'learning to learn'. These are widely assumed by policy-makers and practitioners to be well delineated, generic and transferable.

1 Bold italic text indicates the first usage in the text of a term in the glossary (Appendix 3).

The logic of lifelong learning suggests that students will become more motivated to learn by knowing more about their own strengths and weaknesses as learners. In turn, if teachers can respond to individuals' strengths and weaknesses, then retention and achievement in formal programmes are likely to rise and 'learning to learn' skills may provide a foundation for lifelong learning. Perhaps a more instrumental impetus is provided by pressures on resources in many post-16 institutions. For example, if students become more independent in their learning as a result of knowing their strengths and weaknesses, then negative effects from lower levels of contact between lecturers and students will be counterbalanced if students develop more effective learning strategies which they can use outside formal contact time.

There is therefore a strong intuitive appeal to the notion that we all have individual preferences and styles of learning. Further evidence for the idea that we have individual learning styles appears to be offered when teachers notice that students vary enormously in the speed and manner with which they pick up new information and ideas, and the confidence with which they process and use them.

A complex research field

Yet beneath the apparently unproblematic appeal of learning styles lies a host of conceptual and empirical problems. To begin with, the learning styles field is not unified, but instead is divided into three linked areas of activity: theoretical, pedagogical and commercial.

The first area of activity is a growing body of theoretical and empirical research on learning styles in the UK, the US and Western Europe that began in the early years of the 20th century and is still producing ideas and an ever proliferating number of instruments. Our review has identified 71 models of learning styles and we have categorised 13 of these as major models, using one or more of the following criteria:

- their theoretical importance in the field as a whole
- their widespread use, either commercially or academically
- their influence on other learning styles models.

The remaining 58 (listed in Appendix 1) are not critically analysed in this report. Many consist of rather minor adaptations of one of the leading models and therefore lack influence on the field as a whole; a large number represent the outcomes of doctoral theses. Some offer new ***constructs*** (or new labels for existing constructs) as the basis for a claim to have developed a new model. Others have been used only on very small or homogeneous populations, and yet others have had a brief vogue but have long fallen into obscurity. It is important to note that the field of learning styles research as a whole is characterised by a very large number of small-scale applications of particular models to small samples of students in specific contexts. This has proved especially problematic for our review of evidence of the impact of learning styles on teaching and learning, since there are very few robust studies which offer, for example, reliable and valid evidence and clear implications for practice, based on empirical findings.

The second area of activity is a vast body of research into teaching and learning which draws researchers from diverse specialisms, mainly from different branches of psychology, but also from sociology, business studies, management and education. Researchers working in the field of learning styles across or within these disciplines tend to interpret evidence and theories in their own terms. Evidence about learning is guided by contrasting and disputed theories from psychology, sociology, education and policy studies, and is valued in different ways from different perspectives. Education is also influenced strongly by political ideologies and social values that create preferences about which type of theory is given greatest weight.

The problem is compounded by the way in which academic researchers develop their reputations by establishing individual territories and specialisms, which are then defended against those from a different perspective. This form of intellectual trench warfare, while common throughout academia, is a particular feature of the learning styles movement that militates against cumulative knowledge and cooperative research.

The third area of activity consists of a large commercial industry promoting particular inventories and instruments. Certain models have become extremely influential and popular: in the US, for example, the Dunn and Dunn learning styles model is used in a large number of elementary schools; while in the UK, both Kolb's Learning Style Inventory (LSI) and Honey and Mumford's Learning Styles Questionnaire (LSQ) are widely known and used. The commercial gains for creators of successful learning styles instruments are so large that critical engagement with the theoretical and empirical bases of their claims tends to be unwelcome.

Many teachers use the most well-known instruments with explicit acknowledgement of the source and a clear idea of why they have chosen a particular model. However, it is also common, particularly on in-service training, management or professional development courses, for participants to analyse their learning styles using an unnamed questionnaire with no accompanying explanation or rationale. In many ways, the use of different inventories of learning styles has acquired an unexamined life of its own, where the notion of learning styles itself and the various means to measure it are accepted without question. Mainstream use has too often become separated from the research field. More problematically, it has also become isolated from deeper questions as to whether a particular inventory has a sufficient theoretical basis to warrant either the research industry which has grown around it, or the pedagogical uses to which it is currently put.

A final aspect of complexity is that researchers produce their models and instruments for different purposes. Some aim to contribute to theory about learning styles and do not design their instrument for use in mainstream practice. In contrast, others develop an instrument to be used widely by practitioners in diverse contexts. This difference affects the type of claims made for the instrument and the type of research studies that evaluate it.

These three areas of research and activity, and their potential and pitfalls, militate against the type of integrative review that we are attempting here for the LSRC. We have found the field to be much more extensive, opaque, contradictory and controversial than we thought it was at the start of the research process. Evaluating different models of learning styles and their implications for ***pedagogy*** requires an appreciation of this complexity and controversy. It also requires some understanding of ideas about learning and measurement that have preoccupied researchers in education, psychology and neuroscience for decades.

The extensive nature of the field surprised us: we underestimated the volume of research which has been carried out on all aspects of learning styles over the last 30 years, although most of it refers to higher education and professional learning rather than learning in FE colleges. Three examples illustrate this point. In 2000, David Kolb and his wife Alice produced a bibliography of the research conducted since 1971 on his experiential learning theory and the Kolb Learning Styles Inventory (LSI): it contains 1004 entries. Second, the website for the Dunn and Dunn model has a bibliography with 1140 entries. Lastly, it has been estimated that 2000 articles have been written about the Myers-Briggs Type Indicator (MBTI) between 1985 and 1995 (see Coffield *et al.* 2004 for more details, or the summaries in this report in Section 3).

The enormous size of the research literature in these three areas presents very particular problems for practitioners, policy-makers and researchers who are not specialists in this field. It is extremely unlikely that any of these groups will ever read the original papers and so they are dependent on reviews like this one, which have to discard the weakest papers, to summarise the large numbers of high-quality research papers, to simplify complex statistical arguments and to impose some order on a field which is marked by disunity, dissension and conceptual confusion. The principal tasks for the reviewers are to maintain academic rigour throughout the processes of selection, condensation, simplification and interpretation while also writing in a style accessible to a broad audience.

Competing ideas about learning

Conflicting assumptions about learning underpin mainstream ideas about learning and the best-known models of learning styles. For example, some theories discussed in this report derive from research into the functioning of the brain, where claims are made that specific neural activity related to learning can be identified in different areas of the brain. Other influential ideas derive from established psychological theories, such as personality ***traits***, intellectual abilities and fixed traits which are said to form learning styles. From this latter perspective, it is claimed that learning styles can be defined accurately and then measured reliably and validly through psychological tests in order to predict behaviour and achievement.

Claims about learning styles from the perspective of fixed traits lead to labels and descriptors of styles as the basis for strong claims about the generalisability of learning styles. These can take on unexpected predictive or controversial characteristics. For example, the belief that styles are fixed has led to propositions that marriage partners should have compatible learning styles; that people from socially disadvantaged groups tend to have a particular style; or, as Gregorc believes, that styles are God-given and that to work against one's personal style will lead to ill health (see the evaluation of his Style Delineator (GSD) in Coffield *et al.* 2004; also Table 5, Section 3 of this report.).

Even if we discard these extreme examples, the notion of styles tends to imply something fixed and stable over time. However, different theorists make different claims for the degree of stability within their model of styles. Some theories represent learning styles as 'flexibly stable', arguing that previous learning experiences and other environmental ***factors*** may create preferences, approaches or strategies rather than styles; or that styles may vary from context to context or even from task to task. Nevertheless, supporters of this view still argue that it is possible to create valid and reasonably reliable measures and for these to have diagnostic and predictive use for enhancing students' learning. In contrast, other theorists eschew all notions of individual traits and argue that it is more productive to look at the context-specific and situated nature of learning and the idea of learning biographies rather than styles or approaches.

Competing ideas about learning have led to a proliferation of terms and concepts, many of which are used interchangeably in learning styles research. For example, terms used in this introduction include 'learning styles', 'learning strategies' and 'approaches to learning'. In addition, we have referred to 'models', 'instruments' and 'inventories'. Our investigation has revealed other terms in constant use: '***cognitive*** styles', '***conative*** styles', and 'cognitive structures'; 'thinking styles', 'teaching styles', 'motivational styles', 'learning orientations' and 'learning conditions'. Sometimes these terms are used precisely, in order to maintain distinctions between theories; at other times, they are used very loosely and interchangeably. Some theorists offer clear definitions of their key concepts at the outset, but forget to maintain the limitations they have placed on their language in later papers. Rather than attempting to offer yet another set of definitions of each concept, this report aims to define these terms as clearly as possible within particular families of ideas about learning in order to show how they are used by different learning styles theorists.

Implications for defining and measuring learning styles

It is possible to explain the main dimensions that underpin different approaches to learning styles and this report does so in later sections. Nevertheless, the competing theories and techniques of measuring them, and the effectiveness of such measures are so varied and contested that simple choices about the most suitable approach are difficult to substantiate. Different ideas about learning styles create distinct approaches to identifying the specific attitudes and skills that characterise styles and different measures designed to generalise between learning contexts and types of learner.

Evaluating the claims for various models requires an understanding of the ***psychometric*** vocabulary that underpins particular constructs and measures of ***reliability*** and ***validity***. For example, there are various dimensions to validity, including whether the various test items appear to capture what they set out to measure (***face validity***) and whether the range of behaviours can be seen to have an impact on task performance (***predictive validity***). In addition, a number of other types of validity are important, including ***ecological validity***, ***catalytic validity*** and ***construct validity***. In addition, there is the frequently overlooked issue of ***effect size***.

The notion of reliability is also important because some of the most popular models extrapolate from evidence of reliability to strong assertions of generalisability, namely that learners can transfer their styles to other contexts or that measures will produce similar results with other types of student. We provide a summary of measurement concepts in a glossary in Appendix 3.

Finally, the technical vocabulary needed to understand and interpret the various claims about learning styles also requires an appreciation that for some researchers, a reliable and valid measure of learning styles has not yet been developed; and for some, that the perfect learning style instrument is a fantasy. From the latter perspective, observation and interviews may be more likely than instruments to capture some of the broad learning strategies that learners adopt. Those who reject the idea of measurable learning styles consider it more useful to focus on learners' previous experiences and motivation.

Implications for pedagogy

A number of options for pedagogy flow from the different perspectives outlined in this introduction. For example, supporters of the concept of fixed traits and abilities argue that a valid and reliable measure is a sound basis for diagnosing individuals' learning needs and then designing specific interventions to address them, both at the level of individual self-awareness and teacher activity. This, however, might lead to labelling and the implicit belief that traits cannot be altered. It may also promote a narrow view of 'matching' teaching and learning styles that could be limiting rather than liberating.

In order to counter such problems, some theorists promote the idea that learners should develop a repertoire of styles, so that an awareness of their own preferences and abilities should not bar them from working to acquire those styles which they do not yet possess. In particular, as students move from didactic forms of instruction to settings with a mixture of lectures, seminars and problem-based learning, it may become possible for them to use a range of approaches. This can lead to a plan for teachers to develop these styles through different teaching and learning activities, or it can lead to what might be seen as a type of 'pedagogic sheep dip', where teaching strategies aim explicitly to touch upon all styles at some point in a formal programme.

Other theorists promote the idea of learning styles instruments as a diagnostic assessment tool that encourages a more self-aware reflection about strengths and weaknesses. For supporters of this idea, the notion of learning styles offers a way for teachers and students to talk more productively about learning, using a more focused vocabulary to do so. Finally, those who reject the idea of learning styles might, nevertheless, see value in creating a more precise vocabulary with which to talk about learning, motivation and the idea of ***metacognition*** – where better self-awareness may lead to more organised and effective approaches to teaching and learning.

A large number of injunctions and claims for pedagogy emerge from the research literature and we provide a full account of these in Coffield *et al.* (2004), together with an indication of their strengths and weaknesses. These are summarised in this report in Section 4. However, although many theorists draw logical conclusions about practice from their models of learning styles, there is a dearth of well-conducted experimental studies of alternative approaches derived from particular models. Moreover, most of the empirical studies have been conducted on university students in departments of psychology or business studies; and some would criticise these as studies of captive and perhaps atypical subjects presented with contrived tasks.

Learning styles in practice – ii

It is Monday morning in a college classroom where a group of 30 students – mostly aged between 16 and 19, with a few older learners – are in the second week of their advanced-level catering course. They are following a communication skills module, which is a mix of study skills and presentational techniques. A lecturer hands out a questionnaire on learning styles and introduces it: 'Today I want you to reflect on your learning styles because this will help you assess your strengths and weaknesses, improve the skills you already have and develop skills you might not be so good with.' The students dutifully spend 15 minutes scoring each item, which asks them to reflect on what they like or do not like (eg 'I prefer learning things from books'). They then categorise the statements they ticked into four groups: pragmatists, theorists, activists and reflectors. Each category has a descriptor, similar to a thumbnail sketch of strengths and weaknesses. A quick show-of-hands review by the lecturer reveals that some of the group have an even spread of categories, while a few are heavily skewed towards one style.

'*So, Craig, what have you come out as?,' he asks a young man in the front row.*

'*I'm a pragmatist and a bit of something or other – activist.'*

'*What do you reckon that tells you about your learning style, then?'*

'*Well, I'm gobby and I like talking a lot and I don't like all that boring stuff in books, or when lecturers waffle on and it's not relevant to catering at all.'*

'*OK. Sally, what about you?'*

'*I'm a reflector 'cos I keep myself to myself and I'm dead shy in groups with talking and things.'*

This quick survey shows that few in the group have predominantly abstract tendencies, while most of the group are more oriented towards the concrete. Most of the group become restless during the debriefing, although the adult learners are clearly more interested. The lecturer finishes: 'Well, it's a good idea to go back to all the statements that you put a cross by, and see if you can find ways to develop those skills over the next two years because the idea is to have a spread of styles, not just to go with your preferred style.'

This occasion is the first and last time the students consider their learning styles during the 2-year course. The questionnaire used has no identifiable source or author, no accompanying explanation other than the brief descriptors of the four styles, and no indication at all of what teachers or students should do with the information. The lecturer came across the questionnaire during a session in his initial teacher training course, where it was administered in a similar way to his approach with the catering students. The event makes it possible for the course leader to claim in the self-assessment document for the forthcoming inspection that the college 'diagnoses students' learning styles'. Six months later, inspectors commend this practice in their report.

Summary

Both examples of using an inventory of learning styles in this section are authentic and known at first hand by one of the researchers writing this report. The context we have outlined indicates some of the conceptual and empirical complexity and controversy that characterise the field of learning styles research. We aim to cut through this, and to offer recommendations about the use of different inventories of learning styles in post-16 education to a range of audiences. The scope of our review, its aims, objectives and research questions are discussed in Section 3. We hope that one outcome of our review might be that the use of learning styles summarised at the beginning of this section is underpinned by better understanding. More importantly perhaps, a second outcome would be that practices such as the one summarised at the end of this section are not commended as good practice.

Section 2

The context of post-16 learning

Introduction

Post-16 learning in the UK is not a well-defined, autonomous and self-regulating area of activity, but a highly complex field. It is heavily influenced by economic changes, new technologies, competing interest groups and by government policies as well as by the institutions, professionals and students at the heart of the system. The learning and skills sector, created by Act of Parliament in 2000, is an amalgam of different traditions in post-16 education and training, and comprises a huge number of organisations (providers, inspectors and awarding and regulation bodies), all with different systems for designing and implementing curricula, assessing quality and training practitioners. In addition, there are particular traditions, cultures and ideas about teaching and learning within different post-16 contexts that create both opportunities for and barriers to the widespread use of learning styles across the sector. The complexity and diversity of this sector present a serious challenge to any attempt to promote an informed interest in the different approaches to learning styles as a means of improving pedagogy.

This section will describe the main structural features of the post-16 sector and will discuss the potential of learning styles to influence pedagogy within current pressures on the system. It will focus on the following areas, which in themselves give some indication of the complexity of the new system:

1
policy initiatives

1.1
the learning and skills sector

1.2
higher education in FE colleges

1.3
ideas about 'best practice'

1.4
leadership and management

2
sectoral and institutional pressures

2.1
further education

2.2
work-based learning (WBL)

2.3
adult and community education (ACE)

3
qualifications and curricula

4
initial teacher training and professional development in further education

5
student motivation.

Policy initiatives

The learning and skills sector

The scope of post-16 learning has broadened considerably since the establishment of the Learning and Skills Council (LSC) in 2000 and now embraces not only FE colleges, but also sixth forms in schools and colleges, adult and community education (ACE) in local education authorities (LEAs) and voluntary organisations, lifelong learning, workplace learning and basic skills for adults. The LSC covers all publicly funded post-16 learning and training with the exception of higher education. In England, the LSC has responsibility for some 6m learners and an annual budget of more than £7bn. The learning is – to use the instrumental metaphor found in official texts – 'delivered' by over 4000 providers in a range of settings from classrooms and community projects to workplaces and Learndirect centres; and courses are designed and accredited by hundreds of awarding bodies. The largest element within the sector is the FE colleges, more than 400 in total, which account for around 60% of LSC funding. The inclusion of adult and community education (ACE), with its many providers new to systems of inspection, teacher training and quality assurance, adds a new layer of complexity.

The attitude of the government to the sector can be gauged by reference to the discussion document, *Success for all: reforming further education and training* (DfES 2002a) which listed five problems, but only three strengths. The former can be briefly summarised as follows.

- Decision making has been reactive to funding opportunities, rather than proactive.
- The quality of providers varies widely 'with a number of truly excellent providers and excellent departments within colleges, co-existing with some poor and much mediocre provision' (DfES 2002a, 5). There has not been sufficient attention paid to teaching and learning.
- There has been too little strategic planning for the long term.
- The sector is staffed by an underdeveloped workforce 'with unhealthy levels of casualisation' (2002a, 5). The sector also suffers from *'significant recruitment and retention problems'* (2002a, 20) among both teachers and managers. In 1998, only 55% of FE staff were on permanent contracts, while the rest were employed on part-time, temporary or short-term contracts (FEFC 2000).
- '…too much learning is taking place in unattractive and inefficient buildings' (DfES 2002a, 5), caused by a legacy of under-investment in the capital infrastructure.

These considerable problems are balanced, in the government's view, by three significant strengths within the sector.

- A distinctive commitment to social inclusion, widening participation and opening up access to learning to disadvantaged people. FE colleges attract 27% of their students from the 15% of electoral wards that are the most disadvantaged (DfES 2002a, 4).
- Long-standing relationships with partners and strong credibility with local people, often based on strong learner support.
- 'good practice in learning delivery, often involving inspirational creativity by front-line staff' (DfES 2002a, 6).

Teachers and trainers within the sector are also to be supported by a National Leadership College, led by a consortium of HE institutions and LSDA. It will offer induction programmes for new FE college principals, managers of work-based learning (WBL) and adult and community education (ACE), together with training for those wishing to become senior managers. We discuss these proposals below.

Higher education in further education

Governmental policy initiatives have had, and continue to have, a significant impact on the general climate within which all teaching and learning in the sector takes place. For example, the prime ministerial target of 50% of 18–30 year olds in higher education before 2010 is unlikely to be met unless there is a major increase in the amount of higher education that is taught within further education. In 1999/2000, there were as many as 149,000 students of higher education in English FE colleges (NAO 2002), including 3000 postgraduates, amounting to around 10% of total postgraduate numbers. By comparison, in Scotland, almost one-third of all higher education is taught within FE colleges. The policy of widening participation is likely to find tutors in the post-16 sector more accustomed to dealing with increased student diversity than their counterparts in higher education, but non-traditional students remain more expensive to teach, no matter where they are taught. Moreover, both higher and further education now contain higher percentages of mature students, who have the highest drop-out rates in the first year of study – 16% of mature students in higher education drop out, as compared to only 8% of their younger counterparts (HEFCE 2001).

The qualitative research carried out by the National Audit Office (NAO 2002) on student 'drop-out' involves higher rather than further education, but is arguably the best evidence available. It identified five main reasons for students withdrawing during their first year of study: a lack of preparedness for higher education, changing personal circumstances or interests, financial matters, the impact of undertaking paid work, and dissatisfaction with the course or institution. What is important about this list is that only two of the reasons (the first and the last) are connected with the quality of provision. Part of the contemporary context, then, for students in higher/further education is financial hardship, with as many as 47% of full-time HE students in employment during term time (Callender and Kemp 2000).

Proposals to extend higher education taught in FE colleges and to increase the number of institutions designated as 'universities' mean that research into learning styles and at approaches in higher education, such as that by Entwistle and Vermunt (whose models are reviewed in Section 3) becomes even more relevant to FE colleges (see Coffield *et al.* 2004). However, even if a more considered approach to learning styles were to be adopted in higher education taught in FE colleges, time for staff development – already heavily dominated by policy initiatives – is at a premium.

Ideas about best practice

In November 2002, the government issued its vision for the future of the learning and skills sector in the second version of *Success for all* (DfES 2002b), which sets out a strategy for investment and reform. One of the key elements of the strategy is to 'put teaching, training and learning at the heart of what we do by establishing a new Standards Unit to identify and disseminate best practice, which will guide learning and training programmes' (DfES 2002b, 5). The Standards Unit has begun to identify 'best practice' in delivery, assessment, content and teaching techniques; but it appears to be focusing, initially at least, on practitioners' views (particularly those from the new Beacon colleges; see below) and inspection reports as the sources for 'best practice'. It is not clear yet what theory of learning informs its views, how it intends to engage with external research, what research it will commission, or what view it has about the relevance of learning styles.

This review should help the unit form a view on learning styles and pedagogy. An informed view is important in the light of assumptions about learning styles found in other policy initiatives, such as the Further Education National Training Organisation (FENTO) standards for teacher training (see below), and in initiatives for inclusive practice. As Klein *et al.* (2003) point out in their report on the implications of using the Dunn and Dunn model in FE colleges, reviewed in Coffield *et al.* 2004, there are numerous assumptions about learning styles in initiatives for inclusive education. Yet it is not clear how supporters of these general assumptions have developed their views about the importance of learning styles. For example, the influential Tomlinson Report for the Further Education Funding Council (cited in FEFC 1996, 16) on provision for learners with learning difficulties and/or disabilities argues that:

There is a world of difference between, on the one hand, offering courses of education and training and then giving some students who have learning difficulties some additional human or physical aid to gain access to those courses and, on the other hand, redesigning the very processes of learning, assessment and organisation to fit the objectives and learning style of the student.

The extent to which this view of inclusive learning is now prevalent in the post-16 sector is evident in other policy documents. For example, advice by the LSDA to work-based learning providers advocates careful diagnostic assessment (Green 2002). This LSDA report cites a Department for Education and Employment (DfEE) study from 2001 that presents 'learning style' as one dimension in a jigsaw of components that should be encompassed in the initial diagnostic assessment of trainees. It is not evident that these injunctions by Tomlinson (cited in FEFC 1996) and the LSDA (Green 2002) are based on any research on learning styles. Instead, there is a tendency to assume the existence of styles and the desirability of diagnosing and matching them through teaching and resources and individual learning plans. The assumption of the Tomlinson Committee, quoted above, is presented in broad terms by the FEFC to form the basis of one of its official principles of inclusive learning (FEFC 1996). In her report on initial assessment, Green offers more detail about the importance of learning styles, but does not reference any specific source. She asserts that (2002, 12):

Learning style inventories will provide details of different learning preferences. Outcomes can be used in different ways. Knowledge of learning preferences can help learners exploit opportunities to learn through activities that match them well with [their] *preferred style. However, there should also be support for learners to learn when teaching/training strategies do not match well with preferences.*

Other official documents use the general language of individual needs, and sometimes add assertions about learning preferences. For example, in a support pack for staff development for teachers of students with mental health problems, the DfES (2003, 41) claims that 'like all learners, learners with mental health problems will have preferences as to how and when they learn best'. Although the emphasis in the LSDA report is on preferences as opposed to style, but again, it is not clear how far the idea is rooted in any research on learning styles.

In a similar vein, general assumptions about individual needs and learning styles are prevalent in initiatives to widen participation in post-16 education. A recent report for the LSC on 'good practice' in colleges that are aiming to widen adult participation cites the example of a particular college to commend the ways in which 'Learner/learning support is treated as an entitlement. Support is packaged in a *holistic* way to meet individual needs, including practical and financial support as well as additional learning' (Taylor 2002, 34). In other examples cited in Taylor's report, individual learning 'needs', individual pathways and initial assessment and learning plans reinforce the idea that 'good practice' is essentially a response to individuals. As a result, Taylor (2002) commends a series of 'simple practitioner manuals devised in one college as a guide to learning methods and styles'.

Inspectors' reports sometimes offer general assertions about the importance of meeting individual needs and differentiating teaching to accommodate them, but Office for Standards in Education (Ofsted) and Adult Learning Inspectorate (ALI) reports shows inconsistency in whether inspectors commend individualisation as 'good practice' or not. In a random sample of 30 reports by the ALI, reviewed for our report, all place a strong emphasis on individualisation. Reports commend creating and using individual learning plans and responding to individual needs in the classroom. Yet there is no consistency in whether inspectors commend the use of learning styles. Of the 30 reports, 15 mentioned the notion once in a general way. For example, 'tutors carefully select a good range of learning materials, directly relevant to the needs, interests and learning styles of the learner' (ALI 2002a, 21); 'teaching and planning folders contain … useful guidance … on learning styles, teaching and learning approaches, assessment and resources' (ALI 2003a, 6); [an initial diagnostic assessment comprised] 'a basic skills test and an occupational and learning styles assessment to agree an individual plan of activities based on the specific needs of each learner' (ALI 2003b, 35–36).

The extent to which reports commend individualisation depends partly on the demands of a subject area: for example, competence-based qualifications in a college drop-in centre for business and administration lend themselves more easily to individual learning plans and programmes than, say, an A-level in history. It also seems that views of good practice depend on traditions within different sectors, reflected in the views of individual inspectors who come from those traditions. For example, a report on adult education in an LEA hardly mentions individual diagnosis or meeting individuals' needs, but praises teachers for the ways that learners work in groups and learn from each other (ALI 2003c). A communal view of learning is more evident in the adult education reports than in the FE and work-based learning ones.

Despite the general nature of claims about good practice and inconsistency as to whether such claims are commended officially, an interesting feature of such citations is that they begin to take on a circularity that makes it difficult to challenge what 'good practice' really is. For example, Taylor's report (2002, 56) notes a problem that arises when examples 'are self-reported by project managers and are taken as given by authors of evaluations [of policy initiatives]… As responsiveness to learners' needs is generally agreed to be a characteristic of good practice, such attempts to develop facilities may be regarded as being examples of positive practice'. The purpose of raising this point is not to challenge the importance of responding to learners' needs: instead, it is to question the ease with which assumptions which are not supported by research become mantras about 'good practice' and then policy injunctions.

One of the reasons given by the government for this more interventionist approach is the widely diverging standards of learner achievement within the sector. Ofsted (2002) reports, for instance, that 15% of colleges fail inspection and a further 44% have some aspect of their performance assessed as unsatisfactory. This welcome new focus on teaching and learning adds urgency to the question: what is considered 'good' or 'best' practice in the use of learning styles?

Leadership and management

A leadership college to be known as the Centre for Excellence in Leadership to train senior and middle managers across the learning and skills sector was established in 2003 as a consortium of the LSDA, the Ashridge Management Centre, the University of Lancaster's Management School and the Open University. The need for such an organisation is confirmed by reports such as that by the LSDA (Frearson 2003), which found the quality of management and leadership to be extremely variable; for example, over half of WBL providers were found to have poor leadership and management of learning (ALI 2002b). The LSDA report also noted that many managers in ACE receive little or no training for their roles, a problem paralleled in the low rates of teacher training for tutors in adult education. In addition, even where managers did take up professional development and training opportunities, the quality and content of these programmes also varied enormously. The survey found other problems in developing managers to support their staff in teaching roles. For example, the chief executives of colleges said in 2002 that they were 'more likely to feel' that they have no time to think beyond crisis management than they did in 1997, while WBL managers were more preoccupied with operational issues than their counterparts in colleges. Moreover, there is a huge problem of an ageing management cohort in further education and difficulty in attracting new managers (Frearson 2003).

In relation to the ability of managers to support teachers in understanding learning and improving pedagogy, Frearson's report (2003) and proposals for the Centre for Excellence in Leadership raise a number of questions. For example, the LSDA survey (Frearson 2003) that formed the basis for the report asked for extensive comments on the appropriateness of the FENTO standards in supporting and enhancing managers' tasks and roles. Yet none of the FENTO standards for managers mention the need for them to understand learning as the basis for helping their staff, although maintaining the morale and motivation of staff is one of the standards. It is therefore unclear how managers are to raise the quality of learning and maintain staff morale if they themselves have no in-depth understanding of teaching and learning.

The absence of teaching and learning as one of the skills or areas of knowledge that managers need is in stark contrast to standards of competence for school head-teachers which place a strong emphasis on teaching and learning. It is also ironic given that the title of the LSDA report (Frearson 2003) is *Tomorrow's learning leaders* and that the title of the new website is 'inspirelearning' (www.inspirelearning.com). One explanation is that designers of the management programme may expect managers in colleges to have their own teaching qualification, although this is unlikely to be the case in WBL and adult education. Another explanation is that government policy since the early 1990s has been to attract non-educationalists to college chief executive posts. Notwithstanding these possibilities, the absence of teaching and learning in management standards for the learning and skills sector is not going to equip managers to make more informed decisions about learning styles and the usefulness of research into them.

Nevertheless, proposals for the Centre for Excellence in Leadership also call for 'research into the diversity of leadership and management tasks, skills, knowledge and attributes to inform the design of relevant, responsive and accessible professional development opportunities' (Frearson 2003, 7). This offers some optimism that managers in the learning and skills sector may develop an in-depth understanding of the 'core business' of the sector, namely learning. This review may help managers to make informed decisions about the relevance of learningstyles and the appropriateness or otherwise of individual models.

Sectoral and institutional pressures

Further education

Of the 400+ colleges within the FE sector, 18 have been awarded Beacon status as a mark of outstanding teaching and learning practices, as judged by the inspectorate. A further 16 have been named Centres of Vocational Excellence (CoVEs) because of a vocational specialism, and another 71 colleges are currently moving successfully through the CoVE accreditation programme (HM Treasury 2002). The government continues, however, to be concerned about the range of performance in the sector: In 1997, for instance, 125 colleges had achievement rates below 65%. This figure was, however, reduced to 48 colleges by 2000; and in general, average success rates in further education have been improving slowly in recent years (HM Treasury 2002).

Any moves to individualise learning as, for example, recommended by Kolb (1984), will be made within a system which, although it does not deserve to be called 'mass education', is nevertheless seriously overcrowded and has been historically under-funded. In June 2002, members of the National Association of Teachers in Further and Higher Education (NATFHE) union went on strike, claiming that teachers in further education were being paid 10% less than their counterparts in the school system. Hodkinson (2002, 263) summarised the major changes to the conditions of work for FE teachers and argued that these changes are having serious consequences on professionalism in the sector:

There are new conditions of service, major external curriculum changes, a reduction of career hierarchies, reduced pay relative to other groups, an increase in part-time and temporary contracts, a new external inspections system, and, most recently, pressure for the rapid development of a fully qualified teaching workforce.

The changes in conditions which Hodkinson has detailed are symptoms of the performance management culture which has spread throughout the sector (Ainley and Bailey 1997; Gleeson and Shain 1999), with the introduction of ever tougher targets, rigorous inspections and annual appraisals of all staff. It is not being suggested here that moves towards a qualified teaching force or that rigorous inspections are in themselves objectionable, but rather that they are additional pressures on a sector which is already undergoing significant change. The researchers (cited in brackets above) argue that the operations of performance management are not neutral in their effects; indeed, they are creating dysfunctional side-effects such as compliant sub-cultures.

These pressures have serious implications for the widespread use of learning styles in further education. For instance, compliance with targets may lead to a surface approach to learning based on simply meeting the assessment requirements. Moreover, pressures on colleges to meet inspection criteria for differentiation or for diagnostic assessment during student induction may lead to an unthinking and uncritical administration of a learning style inventory, as was done in the less considered of the two examples that opened this report (see also Gray, Griffin and Nasta 2000).

Work-based learning

Considerable concern is now being expressed about the quality of work-based training, or at least those sections of it that are funded and inspected by government. The final report of the chief inspector of the Training Standards Council (TSC) made two serious criticisms of the quality of that training. First, the pedagogy of WBL is too little understood: 'Inspection report after inspection report describes weaknesses in the initial assessment of learning needs, in the preparation of individual learning plans, progress reviews, assessment and verification of achievements and careers guidance' (TSC 2001, 4). And second, 'few providers properly understand the disciplines of quality assurance, with nearly half of all those inspected last year awarded grade 4 or 5' – the two lowest grades, describing less than satisfactory or poor provision (TSC 2001, 5).

A subsequent study by Hughes (2002, foreword) for the LSDA confirmed that the 'noticeable deterioration [of work-based training] in the last year of operation of the Training Standards Council has accelerated under the Adult Learning Inspectorate'. This report analysed both quantitatively and qualitatively all inspection grades of work-based training for the four years from 1998 to 2001 and concluded that the areas of concern which were repeatedly highlighted by the inspectors were: inadequate management of the data, low levels of retention and achievement, the poor quality of assessment, and the unsystematic development of staff.

Given the poor state of pedagogy in WBL (ALI 2002b), a good deal of staff development will be needed if learning styles are to be used effectively. However, as Coffield *et al.* (2004) show, inventories such as Honey and Mumford's (see Table 7, Section 3) have been widely used in workplaces. In addition, the research of Allinson and Hayes (see Table 1, Section 3) is particularly relevant for WBL because they have investigated the hypothesis that a similarity in cognitive style between managers and subordinates, especially in regard to mentoring, helps to produce more positive relationships.

The DfES Standards Unit and other bodies working to improve pedagogy in workplaces will need to evaluate how learning styles can help or hinder their efforts. For example, research on workplace learning shows the importance of considering the subtle effects of workplace culture, ethos and environment and the idiosyncratic features of individual organisations that make learning effective or ineffective (Evans, Hodkinson and Unwin 2002). In addition, initiatives such as Modern Apprenticeships are criticised for being top-down and supply-led, and not based on the specific need for skills, knowledge and attributes in different industries and sectors (see Fuller and Unwin 2003). The complexity of WBL, together with pressures on resources for training mentors, trainers and supervisors, suggest that simplistic generalisations about the need to respond to individual learning styles or to use a particular learning styles inventory will have a limited impact on pedagogy.

Adult and community education (ACE)

In 2001, a large number and diverse range of new providers of post-16 education were incorporated into the learning and skills sector. Adult and community education (ACE) – previously funded and run by LEAs, charities, voluntary organisations and other bodies such as the Workers' Educational Association (WEA) – and prison education are now both encompassed within the remit of the LSC and the ALI.

The ACE sector is likely to experience a number of difficulties in responding to demands for pedagogy based on learning styles. These can be summarised as follows.

- The overwhelming majority of the teaching workforce are part-time and untrained.
- There are strong traditions of informal, critical pedagogy and customised certification of courses that do not lend themselves easily to a transmission or 'delivery' approach to pedagogy.
- Many courses are short and there is a very wide variety of accreditation and qualifications, from diverse awarding bodies.
- In September 2002, the sector began to experience external inspection with injunctions about pedagogy, assessment and quality assurance.

The difficulties in bringing together the diverse organisations that manage, implement and evaluate ACE constitute a barrier to serious consideration of effective pedagogy. There are also very different educational traditions within ACE, from critical pedagogy and radical workers' education, to ideas about humanist development, community self-help and learning for leisure. These traditions tend to be implicit in debates about what counts as good teaching and learning, and it is not easy to see how learning styles research could be adapted to the very disparate contexts of ACE. In particular, the strong group and community ethos in much ACE provision remains important to many tutors and learners, making simplistic ideas about individualisation and matching teaching to individual preferences or styles unappealing to many tutors. A community or group ethos is also important to many staff in the National Institute of Adult and Continuing Education (NIACE), which is a crucial organisation when it comes to raising the quality of teaching and learning in the sector.

Qualifications and curricula

Most of the post-16 applications of learning styles inventories evaluated by Coffield *et al.* (2004) were carried out in higher education. This is significant, because the structure, content, teaching and assessment of qualifications in higher education are still determined to a great extent by the institutions and teachers themselves. This is also largely true of ACE tutors who still enjoy considerable flexibility and autonomy in designing and running their courses; so institutions and tutors have the freedom to respond to learning styles positively or negatively.

In stark contrast, mainstream FE provision is focused on the national curricula for general A-levels, Advanced Vocational Certificates of Education (AVCEs, based on Advanced GNVQs), the new GCSEs in vocational subjects (based on Intermediate GNVQs) and National Vocational Qualifications (NVQs). In these qualifications, design, content, pedagogy and assessment are heavily determined by the Qualifications and Curriculum Authority (QCA) and awarding bodies.

In addition, targets for retention and achievement can exert a strong influence on pedagogy within the boundaries of the qualification, by encouraging compliance rather than the sort of creative engagement with ideas about learning styles advocated by some proponents and noted in Section 8 of Coffield *et al.* (2004). Further pressure is created by modular structures, fragmented teaching teams, 40% of FE teachers being on temporary or part-time contracts, and limited course hours: all of these factors militate against continuity and dialogue.

The scope, therefore, for using learning styles as a basis for diagnosis and dialogue about learning is seriously affected by the demands of the qualification and the structure of the curriculum. Some practitioners in FE colleges may be seduced by the claims made for the 'matching' of learning and teaching styles in the hope of maximising achievement, rather than developing a range of learning styles in each student. But in the current state of knowledge, it is far too risky to be prescriptive about the value of individual differentiation or 'matching' or about employing any particular instrument.

Moreover, a significant number of FE teachers move regularly between heavily regulated curricula such as AVCEs to more open-ended ACE programmes. Although there has been greater flexibility for tutors in ACE to determine pedagogy, the link between funding and accredited programmes is now placing new restrictions on ACE programmes. For example, the QCA demands external assessment for all qualifications in the National Qualifications Framework (NQF) and awarding bodies are having to redesign those curricula and assessment regimes that are part of the NQF.

Initial teacher training and professional development in further education

An obvious focus for improving post-16 teachers' understanding of learning styles and their implications for pedagogy is initial teacher education and continuing professional development (CPD). So we need to evaluate the potential for staff to acquire an understanding of learning styles through existing structures.

The extent to which FE college lecturers hold a full teaching qualification (as opposed to a foundation or introductory certificate such as the well-known City & Guilds Further & Adult Education Teachers Certificate) varies greatly. In some colleges, all full-time lecturers are qualified, as are many part-time staff. In others, the figure is much lower: across the college sector as a whole, DfES figures cite 60% for full-time and 43% for part-time staff (2002b, 18). There are no official figures for the rates of qualified staff in the ACE and WBL sectors. On average, FE colleges spend only 1–3% of their budgets on staff development. Moreover, the fragmented, part-time nature of ACE means that opportunities for CPD are even more limited than they are in further education.

However, even where staff have the opportunity to gain a full post-16 teaching qualification, the curriculum is now dominated by the outcome-based standards of FENTO. These standards focus exclusively on FE staff, and the tradition of including a very diverse range of trainers, lecturers and tutors on post-16 initial teacher training courses is at risk of being eroded by the need to include FENTO standards in such programmes. In addition, most post-16 teacher training is now run by colleges or by colleges in partnership with universities. Conditions of service in colleges to enable teacher education staff to keep up to date with research evidence are not favourable, and there is wide variation within the sector.

At one level, it could be argued that the problem has already been solved: the requirement to possess knowledge and understanding of learning styles is already part of FENTO's current standards, which include no less than nine references to learning theory, learning styles and the learning cycle. The learning cycle referred to is likely to be Kolb's (see Table 9, Section 3) since his model is widely used in post-16 teacher education courses (see eg Huddleston and Unwin 1997; Gray, Griffin and Nasta 2000). For instance, the standards (FENTO 1999) stipulate that FE teachers should:

- have domain-wide knowledge and critical understanding of … learning theory, teaching approaches and methodologies
- encourage learners to adopt styles of learning that are appropriate to the required outcomes
- establish and agree individual learning needs, aspirations and preferred learning styles
- have a generic knowledge of the role of assessment in relation to the learning cycle.

FENTO is to be reorganised under the new Sector Skills Councils (SSCs) and its future is not yet clear. Moreover, the DfES Standards Unit has the training and professional development of FE teachers within its remit and it is not yet clear what the unit intends to do about the content and format of teacher education for the sector.

At a deeper level, however, the nine requirements concerning learning styles constitute only a very insignificant part of the total battery of standards which take 28 pages to list (FENTO 1999). Trainers of FE teachers who wish to give proper attention to learning styles must also ensure that their trainees possess professional knowledge and understanding of 22 areas, 22 personal skills, 15 personal attributes and eight key areas of teaching which are broken down into 26 sub-areas. So, despite the inclusion of learning styles in the standards, there can be time to deal with them only in a very cursory fashion in the rush to complete this excessively overcrowded curriculum within 1 year full-time or 2 years part-time, which is how most FE lecturers undertake initial teacher training. The textbooks for such courses cover the topic of learning styles in a few pages (see eg Gray, Griffin and Nasta 2000).

Despite these serious limitations, there is still scope within in-service BA Post-16 Education courses and in master's degrees for post-16 teachers to explore learning styles; staff running such courses in colleges and universities are therefore an important audience for this report.

The professional development of staff in the post-16 sector has not just been neglected in the UK, as can be seen from Grubb's empirical study (Grubb *et al.* 1999) of teaching in community colleges in the US. The research was based on direct observation of teaching in 257 classrooms in 32 colleges in 11 states in the US, which revealed a widespread neglect of pedagogy. The instructors who were interviewed had received no formal training in teaching methods, tended to discount the study of pedagogy and developed their approaches to teaching through trial and error or through discussion with their peers, whenever possible. In the words of Grubb *et al.* (1999, 25):

Many faculty find it difficult to answer questions about their teaching: they have neither the time nor the reasons to discuss teaching, and they lack colleagues with whom to do it… Some don't even think of themselves as teachers, even though they are nothing but… Their inability to talk analytically about what is, after all, their life's work reflects in part a pragmatic view of what they need to do.

Grubb and his colleagues stress two key issues as a result of this research: the need for teaching to be seen as a collective rather than an individual activity, and for institutional support to develop pedagogy. It remains an open question whether similar approaches to pedagogy would be found among tutors and trainers in the post-compulsory sector in the UK and this area constitutes a serious gap in current knowledge. It could be argued that one of the essential marks of a profession is the ability to articulate, defend and improve its practice.

Students' motivation

The 16-year-old students who are now entering further education or training at work are those who have experienced the National Curriculum and national assessment over the previous 10 years, and they will have formed particular responses to the intensified regime of formal assessment. The systematic review (Harlen and Deakin Crick 2002) by The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) of the impact of *summative assessment* and testing on students' motivation for learning while at school has particular relevance for the post-compulsory sector. The EPPI-Centre's review contains many important findings, but only two of the most significant are quoted here, as follows (2002, 62–63).

- *'High stakes' assessment (ie assessment that determines progression or selection) can create a classroom climate in which transmission teaching and highly structured activities predominate, favouring only those students with certain learning* dispositions.
- *Repeated practice tests reinforce the low self-image of the lower achieving students.*

The evidence from the maintained sector of schools clearly shows, then, that a rigorous assessment regime affects not only the pedagogy of teachers, but favours the learning approaches of some students and lowers the self-esteem of those who are most likely to leave school at 16 for further education or employment.

Post-16 applications of learning styles have focused in the main on older students (undergraduates and postgraduates aged 18 to 21) who have chosen to enter higher education or undertake professional development. In contrast, FE colleges, WBL providers and ACE all deal with an extremely diverse student population in terms of motivation, confidence and attitudes to learning. For example, a recent study of FE students has shown that teachers may not be challenging students sufficiently to go beyond their existing comfort zones and expectations of getting through the assessment requirements easily (Ecclestone 2002).

For post-16 students, previous experience, current reasons for being in post-16 education and other pressures such as employment, social and personal/family life are all important factors that contribute to how they respond to the concept of learning styles, and whether a particular instrument labels them, leaves them with the comfort of their preferred learning style, or offers them more open-ended ideas about learning.

Conclusion

The potential for learning styles to improve post-16 learning cannot be evaluated without reference to:

- the enormous range of students
- the increasing numbers of non-traditional students
- large numbers of untrained, part-time tutors
- the prevailing audit culture and the performance management system of 3-year funding plans, 'floor targets' which will set minimum acceptable levels of performance (see DfES 2002b) and extra funding linked to the achievement of 'improvement targets'
- the effects of competition between providers, despite a new political emphasis on collaboration
- the multiple purposes of the sector (academic, vocational, recreational, basic skills, workforce development)
- the range and number of curricula and awarding bodies
- the potential of information and communications technology (ICT)
- the impact of funding and other steering mechanisms on teaching, learning and assessment.

In sum, all teacher–student interactions in post-16 learning are embedded in structures of power, regulation and control. These mean, for instance, that neither teachers nor students have the total freedom to choose the teaching or learning strategies which they may wish to adopt. There are also so many constraints on teachers and so many variables affecting learning outcomes that the differences produced through approaches based on learning styles are likely to be rather small. The research evidence strongly suggests that all these factors – and the audit culture, in particular – have changed pedagogical relations in further education. It is within this general atmosphere that attempts are being made to improve the professional practice of tutors and the quality of learning by students.

Section 3

The systematic review of learning styles models

Aims of the research

The LSDA commissioned a number of research projects in post-16 learning through a new Learning and Skills Research Centre (LSRC) funded by the LSC and the DfES. The University of Newcastle carried out two projects: an evaluation of models of learning styles inventories and their impact on post-16 pedagogy (this report and Coffield *et al.* 2004) and an evaluation (wih the University of Sunderland) of different thinking skill frameworks (Moseley *et al.* 2003). Other projects in the LSRC's programme include an evaluation by the University of Strathclyde of the impact of thinking skills on pedagogy (Livingston, Soden and Kirkwood 2003), a report on the extent and impact of mixed-age learning in further education by the universities of Surrey and Sheffield (McNair and Parry 2003) and a mapping by the University of Leeds of the conceptual terrain in relation to informal learning (Colley, Hodkinson and Malcolm 2003).

The evaluation of learning styles inventories was originally a separate project from the evaluation of the impact of learning styles on post-16 pedagogy. However, the two projects were merged in order to maximise the synergy between the theoretical research on learning styles and its practical implications for pedagogy.

The aims of the joint project were to carry out an extensive review of research on post-16 learning styles, to evaluate the main models of learning styles, and to discuss the implications of learning styles for post-16 teaching and learning. These broad aims are addressed through the following research questions and objectives.

Research questions

1
What models of learning styles are influential and potentially influential?

2
What empirical evidence is there to support the claims made for these models?

3
What are the broad implications for pedagogy of these models?

4
What empirical evidence is there that models of learning styles have an impact on students' learning?

Research objectives

The objectives that arose from our questions enabled us to:

- identify the range of models that are (a) available; (b) influential or potentially influential in research and practice
- locate these models within identifiable 'families' of ideas about learning styles
- evaluate the theories, claims and applications of these models, with a particular focus on evaluating the authors' claims for reliability and validity
- evaluate the claims made for the pedagogical implications of the selected models of learning styles
- identify what gaps there are in current knowledge and what future research is needed in this area
- make recommendations and draw conclusions about the research field as a whole.

We have also produced a separate report (Coffield *et al.* 2004), which provides detailed reviews of the 13 major models of learning styles (see Tables 1–13 at the end of this section) based on these research questions and objectives.

Approaches to the literature review

The brief for this research was twofold: first, to assess the theoretical basis of claims made for learning styles and their importance for pedagogy; second, to map the field of learning styles and to gain an understanding of the variety of models produced, their history and pedagogical relevance. For this reason, it was not practical to follow the stringent, limiting criteria used in reviews by the EPPI-Centre (see eg Harlen and Deakin Crick 2002), since the second aspect of the project would have been neglected. However, we adopted some of the processes of a systematic literature review, based on the research questions outlined above. These processes included: identifying literature and search terms and locating the literature through materials already in our possession, following up citations, interrogating databases, searching websites, and making use of personal contacts. We developed a reference management system using Endnote software and this enabled us to define and hone our criteria (see Figure 1), both for selecting literature initially and then for closer analysis.

Figure 1
Selection of literature for review

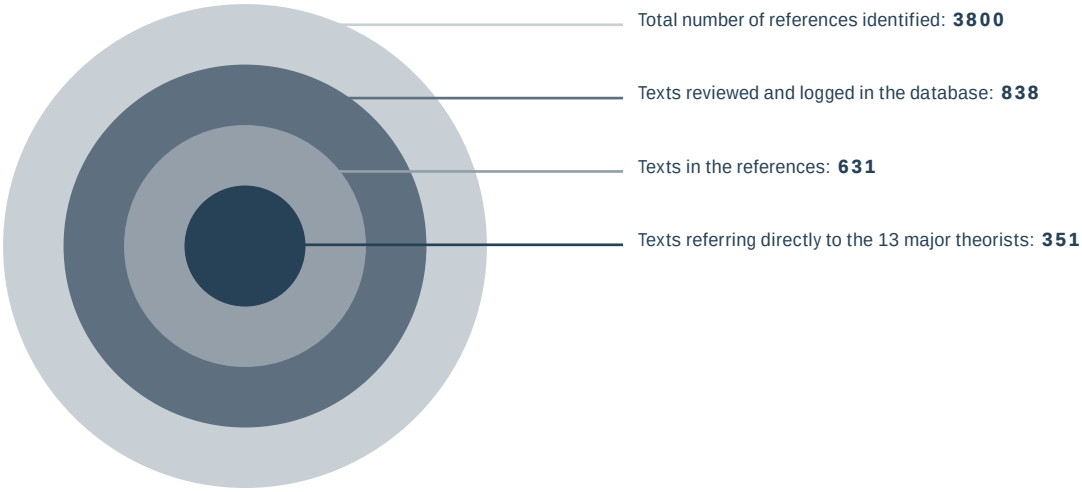
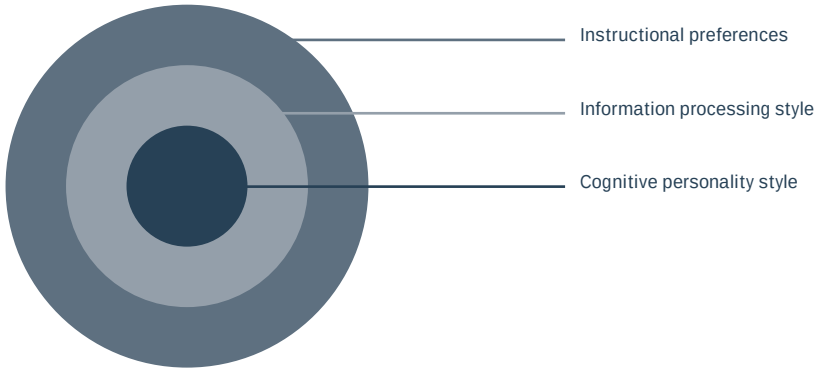


Figure 2
Curry's 'onion' model of learning styles
Source: Curry (1983)



The category 'texts in the references' covers both this report and Coffield *et al.* 2004.

In the literature review, we used a range of search terms (see Appendix 2) which revealed the titles of thousands of books, journal articles, theses, magazine articles, websites, conference papers and unpublished 'grey' literature. Our criteria have been relatively flexible compared with those used in EPPI-Centre reviews, since we have had to take into account the need to sample at least some of the large number of articles in professional magazines designed to promote particular models of learning styles, even though these articles tend not to engage critically with the instrument either theoretically or empirically.

We have accumulated a database containing over 800 references and papers relating to the field of post-16 learning styles. The majority are scholarly articles in journals or books, written by academics for other academics. We have developed the following structure to impose some order on a large, complex and confusing literature, and to evaluate all reports and papers critically. Our evaluation criteria, therefore, take account of both the scholarly quality of an article and its impact on a particular professional or academic audience.

The criteria for selecting particular theorists to study in depth were as follows.

- The texts chosen were widely quoted and regarded as central to the field as a whole.
- The learning styles model was based on an explicit theory.
- The publications were representative of the literature and of the total range of models available (eg experiential, cognitive and brain dominance).
- The theory has proved to be productive – that is, leading to further research by others.
- The instrument/questionnaire/inventory has been widely used by practitioners – teachers, tutors or managers.

The criteria used to reject other contenders were as follows.

- The approach was highly derivative and added little that was new; for example, the names of the individual learning styles had been changed but little else.
- The research's primary focus was on an allied topic rather than on learning styles directly; for example, it was a study of creativity or of teaching styles.
- The publication was a review of the literature rather than an original contribution to the field, such as Curry's (1983) highly influential 'onion' model which groups different approaches into three main types. Such reviews informed our general thinking, but were not selected for in-depth evaluation as models of learning style.
- The study was a standard application of an instrument to a small sample of students, whose findings added nothing original or interesting to theory or practice.
- The methodology of the study was flawed.

It was not necessary for all five inclusion criteria to be met for a particular theorist to be included, nor for all five rejection criteria to be fulfilled for one to be excluded. In fact, it did not prove very difficult or contentious to decide which models were most influential.

Influential models of learning styles

The last part of this section provides summaries of our reviews (reported in full in Coffield *et al.* 2004) of the most influential models and instruments of learning styles and their accompanying literatures, with a particular focus on validity, reliability and practical application. The main models chosen for detailed study are as follows.

- Allinson and Hayes' Cognitive Style Index (CSI)
- Apter's Motivational Style Profile (MSP)
- Dunn and Dunn's model and instruments of learning styles
- Entwistle's Approaches and Study Skills Inventory for Students (ASSIST)
- Gregorc's Mind Styles Model and Style Delineator (GSD)
- Herrmann's Brain Dominance Instrument (HBDI)
- Honey and Mumford's Learning Styles Questionnaire (LSQ)
- Jackson's Learning Styles Profiler (LSP)
- Kolb's Learning Style Inventory (LSI)
- Myers-Briggs Type Indicator (MBTI)
- Riding's Cognitive Styles Analysis (CSA)
- Sternberg's Thinking Styles Inventory (TSI)
- Vermunt's Inventory of Learning Styles (ILS)

The material we have reviewed varies enormously, both in the quality of the methodology and the scope of the investigation. In some instances, studies that might have been excluded in a typical academic review on the grounds of dubious methodology have been included here because of their impact on practitioners or on other researchers, but in all such cases, the methodological weaknesses are made explicit.

Rationale for organising the literature review

A continuum of learning styles

As we pointed out in Section 1, the research field of learning styles is both extensive and conceptually confusing. In a review of the psychometric qualities of different learning styles instruments, Curry (1987) categorised different research approaches. These were: 'instructional preferences', 'information processing style' and 'cognitive style'.

In Curry's model (1983; see Figure 2), the inner layer of cognitive personality style is both more stable (and therefore less easily modified or changed) and more significant in complex learning, while the outer layer of instructional preferences is easier to modify and influence, but less important in learning (1983). Many researchers in the learning styles field have seen Curry's model as a useful, pragmatic way to present different models within these broad categories (eg Price and Richardson 2003). Yet, however attractive the onion metaphor may be, it is far from clear what lies at the centre. Conceptions of cognitive style relate to particular sets of theoretical assumptions, some of them psychoanalytic in origin. Ideas about stability are influenced more by theoretical concerns than by empirical evidence. There is not a single theory of cognitive or of learning style which is supported by evidence from longitudinal studies of stylistic similarities and differences in twins.

As an alternative model, Vermunt (1998; see Figure 3) aimed to integrate different learning processes, some of which are thought to be relatively stable (mental learning models and learning orientations) and some of which are contextually determined (choice between regulatory and processing strategies).

Figure 3
Vermunt's model of learning styles (1998)

Source: Price and Richardson 2003

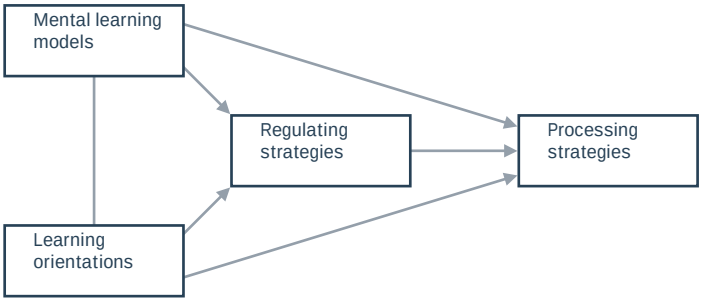
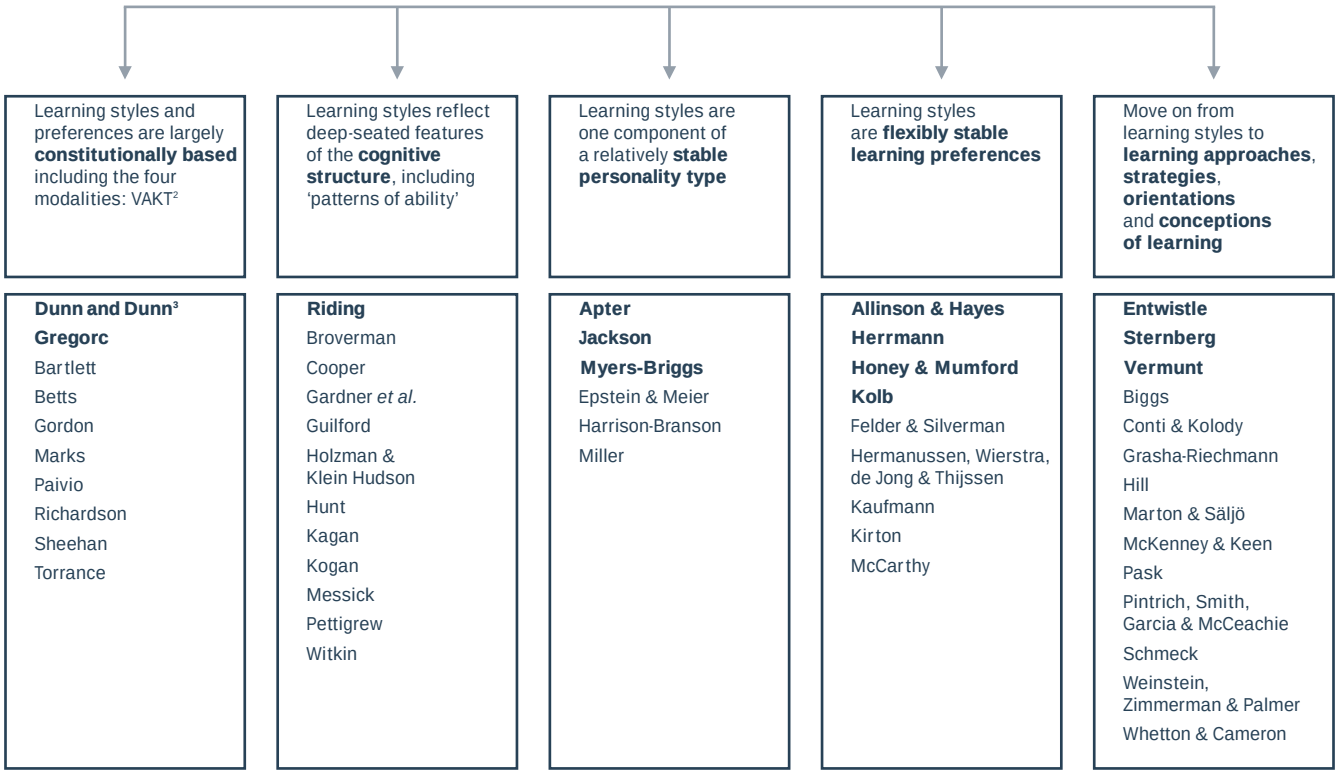


Figure 4
Families of learning styles



2
VAKT = Visual, auditory, kinaesthetic, tactile

3
The theorists in bold type are those chosen for in-depth evaluation

Some of the models we reviewed in Coffield *et al.* (2004), such as the Dunn and Dunn learning styles model (summarised here in Table 3 on page 25), combine qualities which the authors believe to be constitutionally fixed with characteristics that are open to relatively easy environmental modification. Others, such as those by Vermunt and Entwistle (summarised here in Tables 13 and 4 respectively), combine relatively stable cognitive styles with strategies and processes that can be modified by teachers, the design of the curriculum, assessment and the ethos of the course and institution. The reason for choosing to present the models we reviewed in a continuum is because we are not aiming to create a coherent model of learning that sets out to reflect the complexity of the field. Instead, the continuum is a simple way of organising the different models according to some overarching ideas behind them. It therefore aims to capture the extent to which the authors of a model claim that styles are constitutionally based and relatively fixed, or believe that they are more flexible and open to change (see Figure 4). We have assigned particular models of learning styles to what we call 'families'. This enables us to impose some order on a field of 71 apparently separate approaches. However, like any theoretical framework, it is not perfect and some models are difficult to place because the distinction between constitutionally-based preferences or styles and those that are amenable to change is not always clear-cut. We list all 71 in the database we have created for this review (see Appendix 1).

The continuum was constructed by drawing on the classification of learning styles by Curry (1991). We also drew on advice for this project from Entwistle (2002), and analyses and overviews by key figures in the learning styles field (Claxton and Ralston 1978; De Bello 1990; Riding and Cheema 1991; Bokoros, Goldstein and Sweeney 1992; Chevrier *et al.* 2000; Sternberg and Grigorenko 2001). Although the groupings of the families are necessarily arbitrary, they attempt to reflect the views of the main theorists of learning styles, as well as our own perspective. Our continuum aims to map the learning styles field by using one kind of thematic coherence in a complex, diverse and controversial intellectual territory. Its principal aim is therefore classificatory.

We rejected or synthesised existing overviews for three reasons: some were out of date and excluded recent influential models; others were constructed in order to justify the creation of a new model of learning styles and in so doing, strained the categorisations to fit the theory; and the remainder referred to models only in use in certain sectors of education and training or in certain countries.

Since the continuum is intended to be reasonably comprehensive, it includes in the various 'families' many of the 71 taxonomies of learning styles we came across during this project. However, the scope of this project does not allow us to examine in depth all 71 of these instruments and there is therefore some risk of mis-categorisation. The models that are analysed in depth are represented in Figure 4 in bold type.

Our continuum is based on the extent to which the developers of learning styles models and instruments appear to believe that learning styles are fixed. The field as a whole draws on a variety of disciplines, although cognitive psychology is dominant. In addition, influential figures such as Jean Piaget, Carl Jung and John Dewey leave traces in the work of different groups of learning styles theorists who, nevertheless, claim distinctive differences for their theoretical positions.

At the left-hand end of the continuum, we have placed those theorists with strong beliefs about the influence of genetics on fixed, inherited traits and about the interaction of personality and cognition. While some models, like Dunn and Dunn's do acknowledge external factors, particularly immediate environment, the preferences identified in the model are rooted in ideas that styles should be worked with rather than changed. Moving along the continuum, learning styles models are based on the idea of dynamic interplay between self and experience. At the right-hand end of the continuum, theorists pay greater attention to personal factors such as motivation and environmental factors like cooperative or individual learning, and also to the effects of curriculum design, institutional and course culture and teaching and assessment tasks on how students choose or avoid particular learning strategies.

The kind of instruments developed, the ways in which they are evaluated and the pedagogical implications for students and teachers all flow from these underlying beliefs about traits. Translating specific ideas about learning styles into teaching and learning strategies is critically dependent on the extent to which these learning styles have been reliably and validly measured, rigorously tested in authentic situations, given accurate labels and integrated into everyday practices of information gathering, understanding and reflective thinking.

We devised this classificatory system to impose some order on a particularly confusing and endlessly expanding field, but as a descriptive device, it has certain limitations. For example, it may overemphasise the differences between the families and cannot reflect the complexity of the influences on all 13 models. Some authors claim to follow certain theoretical traditions and would appear, from their own description, to belong in one family, while the application (or indeed, the marketing) of their learning styles model might locate them elsewhere. For example, Rita Dunn (Dunn and Griggs 1998) believes that style is (in the main) biologically imposed, with the implication that styles are relatively fixed and that teaching methods should be altered to accommodate them. However, on her UK website (Hankinson 2003), it is claimed that significant gains in student performance can be achieved 'By just understanding the concept of student learning styles and having a personal learning style profile constructed'. Where such complexity exists, we have taken decisions as a team in order to place theorists along the continuum.

Families of learning styles

For the purposes of the continuum, we identify five families and these form the basis for our detailed analyses of different models in Coffield *et al.* (2004):

- constitutionally based learning styles and preferences
- cognitive structure
- stable personality type
- 'flexibly stable' learning preferences
- learning approaches and strategies.

Within each family, we review the broad themes and beliefs about learning, and the key concepts and definitions which link the leading influential thinkers in the group. We also evaluate in detail the 13 most influential models, looking both at studies where researchers have evaluated the underlying theory of a model in order to refine it and empirical studies of reliability, validity and pedagogical impact. To ensure comparability, each of these analyses uses the following headings:

- origins and influence
- definition, description and scope of the learning style instrument
- measurement by authors
  - description of instrument
  - reliability and validity
- external evaluation
  - reliability and validity
  - general
- implications for pedagogy
- empirical evidence for pedagogical impact.

Summary evaluations of the 13 major models of learning styles

The 13 tables that follow summarise our findings on the 13 models chosen for study; the full reviews of each learning style are to be found in Coffield *et al.* (2004).

Allinson and Hayes' Cognitive Styles Index (CSI)

Table 1
Allinson and Hayes' Cognitive Styles Index (CSI)

	Strengths	Weaknesses
General	Designed for use with adults.	
Design of the model	A single bipolar dimension of intuition-analysis, which authors contend underpins other aspects of learning style.	The proposed single dimension is very broad and made up of diverse, loosely associated characteristics.
Reliability	***Internal consistency*** and ***test–retest reliability*** are high, according to both internal and external evaluations.	
Validity	■ The CSI correlates with scales from other instruments, including four from the Myers-Briggs Type Indicator. ■ Analysis is associated with more job satisfaction in junior roles than intuition, while intuition is associated with seniority in business and with success in entrepreneurship.	■ There is unequivocal evidence that intuition and analysis, although negatively related, are not opposites. ■ The authors acknowledge that more research is needed to understand the relationships between cognitive style, intellectual ability and educational achievement.
Implications for pedagogy	■ Intuitive managers are generally better liked, irrespective of the style of their subordinates. ■ Matched styles are often effective in mentoring relationships. ■ One study showed that ***analytic*** qualities in university dissertation supervisors are desirable. ■ If it were to be shown that placing a higher value on intuitive performance by university students led to more successful career and business outcomes, changes in HE pedagogy and assessment would be indicated.	It is not clear how far findings are context-dependent. Implications are, at best, interesting suggestions which need to be tested empirically.
Evidence of pedagogical impact		None as yet.
Overall assessment	Overall, the CSI has the best evidence for reliability and validity of the 13 models studied. The constructs of analysis and intuition are relevant to decision making and work performance in many contexts, although the pedagogical implications of the model have not been fully explored. The CSI is a suitable tool for researching and reflecting on teaching and learning, especially if treated as a measure of two factors rather than one.	
Key source	Allinson and Hayes 1996	

Table 2
Apter's Motivational Style Profile (MSP)

Apter's Motivational Style Profile (MSP)

	Strengths	Weaknesses
General	The theory provides a structure for understanding human behaviour and experience, not in terms of fixed personality 'types', but by outlining the dynamic interplay between 'reversing' motivational states.	The MSP is a measure of personality, not learning style alone.
Design of the model	There are four domains of experience in which there is interaction between emotion, cognition and volition. These are: means-ends, rules, transactions and relationships. Reversal theory is about systems in nature, bridging between biology and lived experience.	Apter's claim that one of the four pairs of motivational states is always in operation is as yet unproven.
Reliability	The MSP has acceptable levels of internal consistency and test–retest reliability.	
Validity	There is an impressive amount of empirical evidence which supports reversal theory.	In general, it cannot be said that ***factor analysis*** has shown the MSP to measure adequately the 'binary oppositions' on which reversal theory is built.
Implications for pedagogy	■ Reversal has major implications for how we think about learning styles, leading us to expect reversals between learning styles as well as some degree of individual consistency over time. ■ Productive learning can be fostered by creating learning environments in which reversals through boredom and satiation are less likely to occur.	The implications of reversal theory for learning have not been fully elaborated or widely researched, except in specialised fields such as sport and addiction.
Evidence of pedagogical impact		None as yet.
Overall assessment	A theory which poses a threat to fixed-trait models of learning style and which merits further research and development in educational contexts.	
Key source	Apter 2001	

Dunn and Dunn's model and instruments of learning styles

Table 3
Dunn and Dunn's model and instruments of learning styles

	Strengths	Weaknesses
General	A user-friendly model that includes motivational factors, social interaction, physiological and environmental elements.	The model makes simplistic connections between physiological and psychological preferences and brain activity.
Design of the model	■ High or low preferences for 22 different factors are identified by learners. ■ Strong preferences form the basis for teachers to adopt specific techniques or make environmental changes to areas such as light, sound, design, time of day or mobility.	■ It is a model of instructional preferences, not learning. ■ It is unsophisticated in its adoption of ideas from other fields, eg modality preference, circadian rhythm, hemispheric dominance. ■ Training courses and manuals simply list large numbers of studies where preferences are either prioritised or connected to others. Practitioners therefore have to take the theoretical support on trust.
Reliability	Supporters make strong claims for reliability.	Critics highlight major problems with the design and reliability of key instruments.
Validity	Supporters make strong claims for validity.	There have been external criticisms of evidence of validity.
Implications for pedagogy	It is claimed that: ■ individual differences in preference can be discerned ■ it is possible to adapt environments and pedagogy to meet these preferences ■ the stronger the preference, the more effect an intervention will have ■ the impact will be even greater if low-achieving learners' strong preferences are catered for.	■ The implications for pedagogy are so forcefully expressed that no other options are considered. ■ Labelling and generalising about types of student may lead to simplistic injunctions about 'best practice'.
Evidence of pedagogical impact	■ The model has generated an extensive programme of international research. ■ Isolation of individual elements in empirical studies allows for evaluation of the effects of those elements.	■ Effect sizes of individual elements are conflated. ■ There is a serious lack of independent evaluation of the LSI.
Overall assessment	Despite a large and evolving research programme, forceful claims made for impact are questionable because of limitations in many of the supporting studies and the lack of independent research on the model. Concerns raised in our review need to be addressed before further use is made of the model in the UK.	
Key source	Dunn and Griggs 2003	

Entwistle's Approaches and Study Skills Inventory for Students (ASSIST)

Table 4
Entwistle's Approaches and Study Skills Inventory for Students (ASSIST)

	Strengths	Weaknesses
General	Model aims to encompass approaches to learning, study strategies, intellectual development skills and attitudes in higher education.	Complexity of the developing model and instruments is not easy for non-specialists to access.
Design of the model	Assesses study/learning orientations, approaches to study and preferences for course organisation and instruction.	There are dangers if the model is used by teachers without in-depth understanding of its underlying implications.
Reliability	Internal and external evaluations suggest satisfactory reliability and internal consistency.	■ Many of the sub-scales are less reliable. ■ Test–retest reliability not shown.
Validity	■ Extensive testing by authors of construct validity. ■ Validity of deep, surface and strategic approaches confirmed by external analysis.	■ Construct and predictive validity have been challenged by external studies. ■ Unquestioned preference for deep approaches, but strategic and even surface approaches may be effective in some contexts. ■ Rather weak relationships between approaches and attainment.
Implications for pedagogy	■ Teachers and learners can share ideas about effective and ineffective strategies for learning. ■ Course teams and managers can use approaches as a basis for redesigning instruction and assessment. ■ Model can inform the redesign of learning milieux within departments and courses.	■ The scope for manoeuvre in course design is variable outside the relative autonomy of higher education, especially in relation to assessment regimes. ■ There is a large gap between using the instrument and transforming the pedagogic environment. ■ As the terms 'deep' and 'surface' become popular, they become attached to individuals rather than behaviours, against the author's intention.
Evidence of pedagogical impact	Has been influential in training courses and staff development in British universities.	Not tested directly as a basis for pedagogical interventions.
Overall assessment	Potentially useful model and instrument for some post-16 contexts outside the success it has had in higher education, but significant development and testing will be needed.	
Key source	Entwistle 1998	

Gregorc's Style Delineator (GSD)

Table 5
Gregorc's Style Delineator (GSD)

	Strengths	Weaknesses
General	The GSD taps into the unconscious 'mediation abilities' of '***perception***' and 'ordering'.	Styles are natural abilities and not amenable to change.
Design of the model	There are two dimensions: concrete-abstract and sequential-random. Individuals tend to be strong in one or two of the four categories: concrete sequential, concrete random, abstract sequential and abstract random.	■ Some of the words used in the instrument are unclear or may be unfamiliar. ■ No normative data is reported, and detailed descriptions of the style characteristics are unvalidated.
Reliability	The author reports high levels of internal consistency and test–retest reliability.	Independent studies of reliability raise serious doubts about the GSD's psychometric properties.
Validity	Moderate ***correlations*** are reported for criterion-related validity.	■ There is no empirical evidence for construct validity other than the fact that the 40 words were chosen by 60 adults as being expressive of the four styles. ■ The sequential/random dimension stands up rather better to empirical investigation than the concrete/abstract dimension.
Implications for pedagogy	Although Gregorc contends that clear-cut Mind Style dispositions are linked with preferences for certain instructional media and teaching strategies, he acknowledges that most people prefer instructional variety.	Gregorc makes the unsubstantiated claim that learners who ignore or work against their style may harm themselves.
Evidence of pedagogical impact	Results on study preference are mixed, though there is evidence that choice of subject is aligned with Mind Style and that success in science, engineering and mathematics is correlated with sequential style.	We have not found any published evidence addressing the benefits of self-knowledge of learning styles or the alignment of Gregorc-type learning and teaching styles.
Overall assessment	Theoretically and psychometrically flawed. Not suitable for the assessment of individuals.	
Key source	Gregorc 1985	

Herrmann's Brain Dominance Instrument (HBDI)

Table 6
Herrmann's Brain Dominance Instrument (HBDI)

	Strengths	Weaknesses
General	■ The HBDI and new ways of using it effectively have been developed over more than 20 years. ■ The 'whole brain' model is compatible with several other models of learning style.	
Design of the model	■ It is based on theory which, although originally brain-based, incorporates growth and development, especially in creativity. ■ Learning styles as defined by the HBDI are not fixed personality traits, but to a large extent, learned patterns of behaviour.	■ As with most self-report instruments, it is possible to complete it with the intention of presenting a particular profile. ■ Some will find the HBDI items hard to read and understand.
Reliability and validity	Internal evidence suggests that the HBDI is psychometrically sound, and new analyses can draw on an enormous international database.	There are very few independent studies of the reliability and validity of the HBDI.
Implications for pedagogy	■ HBDI-based feedback does not seek to attach permanent labels to the individual. ■ Herrmann provides rich accounts of how people think and learn, valuing diversity and arguing for mutual understanding. ■ Teachers, students, managers and workers may be stimulated to examine and refine their ideas about communication and learning. ■ Herrmann argues that all learners need to develop stylistic flexibility and, where appropriate, extend their range of competence.	The pedagogical implications of the 'whole brain' model have not yet been fully explored and tested.
Evidence of pedagogical impact		Although well established in the business world, the use of the HBDI has yet to be extensively validated in education.
Overall assessment	A model which, although largely ignored in academic research, offers considerable promise for use in education and training. It is more inclusive and systemic than many others, taking an optimistic, open and non-labelling stance towards the development of people and organisations.	
Key source	Herrmann 1989	

Honey and Mumford's Learning Styles Questionnaire (LSQ)

Table 7
Honey and Mumford's Learning Styles Questionnaire (LSQ)

	Strengths	Weaknesses
General	LSQ probes the attitudes and behaviours which determine preferences with regard to learning. To be used for personal/organisational development and not for assessment/selection. Not a psychometric instrument, but a checklist about how people learn.	Danger of labelling people as 'theorists' or 'pragmatists', when most people exhibit more than one strong preference.
Design of the model	Based on Kolb's model, with new terms for style preferences which are aligned to the four stages in the learning cycle.	Evaluation by researchers has become increasingly critical, eg percentage of ***variance*** explained by personality and learning style put at 8% (Jackson and Lawty-Jones 1996).
Reliability		Only moderate internal consistency has been found.
Validity	Face validity is claimed by authors.	Validity not assessed by authors. More evidence is needed before LSQ is acceptable.
Implications for pedagogy	■ To help managers/ employees to devise personal development plans. ■ To show managers how to help their staff learn. ■ To be used as a starting point for discussion and improvement with a knowledgeable tutor. ■ Suggestions made to help people strengthen an under-utilised style.	All the suggestions are derived logically or from practice with using the LSQ; they have not been rigorously tested to see if they work.
Evidence of pedagogical impact	No evidence quoted by authors.	No evidence found by researchers.
Overall assessment	Has been widely used in business, but needs to be redesigned to overcome weaknesses identified by researchers.	
Key source	Honey and Mumford 2000	

Jackson's Learning Styles Profiler (LSP)

Table 8
Jackson's Learning Styles Profiler (LSP)

	Strengths	Weaknesses
General	■ The LSP is a sophisticated instrument in terms of its theory base and computerised format. ■ Designed for use in business and education.	
Design of the model	The model describes four styles: Initiator, Analyst, Reasoner and Implementer.	It is possible that the style names chosen by Jackson are not good descriptors of the underlying constructs.
Reliability	The test–retest reliability of three scales is satisfactory.	The Reasoner scale has poor test–retest reliability.
Validity	■ The authors claim ***factorial validity*** on the basis of a four-factor solution. ■ Some evidence of ***concurrent validity*** is provided by correlations with other measures of personality.	Some further refinement of items is needed, especially in the linitiator scale.
Implications for pedagogy	■ There is a positive emphasis in the computer-generated recommendations for personal development which result from completing the questionnaire. ■ The feedback is very detailed and contains suggestions for building on strengths, dealing with challenging situations and remedying maladaptive learning.	It is desirable, both for individuals and organisations, to build up multiple strengths rather than for people to work only in ways which come most naturally to them.
Evidence of pedagogical impact		The relevance, practicality and value of the personal feedback have yet to be evaluated.
Overall assessment	The theoretical model and the LSP, for which UK norms exist, have promise for wider use and consequential refinement in organisational and educational contexts.	
Key source	Jackson 2002	

Kolb's Learning Style Inventory (LSI)

Table 9
Kolb's Learning Style Inventory (LSI)

	Strengths	Weaknesses
General	■ Learning styles are not fixed personality traits, but relatively stable patterns of behaviour. ■ 30 years of critique have helped to improve the LSI, which can be used as an introduction to how people learn.	Should not be used for individual selection.
Design of the model	■ Learning styles are both flexible and stable. ■ Based on the theory of experiential learning which incorporates growth and development.	Three elements need to be separated: ■ process = the four stages of the learning cycle ■ level = how well one performs at any of the four stages ■ style = how each stage is approached.
Reliability	Changes to the instrument have increased its reliability.	Long, public dispute over reliability of LSI. Third version is still undergoing examination.
Validity		■ The construct validity of the LSI has been challenged and the matter is not yet settled. ■ It has low predictive validity, but it was developed for another purpose – as a self-assessment exercise.
Implications for pedagogy	■ In general, the theory claims to provide a framework for the design and management of all learning experiences. ■ Teachers and students may be stimulated to examine and refine their theories of learning; through dialogue, teachers may become more empathetic with students. ■ All students to become competent in all four learning styles (active, reflective, abstract and concrete) to produce balanced, integrated learners. ■ Instruction to be individualised with the help of IT.	■ The notion of a learning cycle may be seriously flawed. ■ The implications for teaching have been drawn logically from the theory rather than from research findings.
Evidence of pedagogical impact		■ There is no evidence that 'matching' improves academic performance in further education. ■ The findings are contradictory and inconclusive. No large body of unequivocal evidence on which to base firm recommendations about pedagogy.
Overall assessment	One of the first learning styles, based on an explicit theory. Problems about reliability, validity and the learning cycle continue to dog this model.	
Key source	Kolb 1999	

Myers-Briggs Type Indicator (MBTI)

Table 10
Myers-Briggs Type Indicator (MBTI)

	Strengths	Weaknesses
General	Provides a view of the whole personality, including learning.	Not specifically about learning.
Design of the model	Based on Jung's theory on four bipolar scales, producing a possible 16 personality 'types'.	The relationships between elements and scales – 'type dynamics' – are extremely complex.
Reliability	Reliability co-efficients are high for individual pairs of scores relating to each of the scales.	The stability of the 16 types is less impressive.
Validity	The face validity of the MBTI is generally accepted.	Construct validity is controversial because of the debate about whether the constructs are best represented by opposing pairs.
Implications for pedagogy	■ The apparent correlation between achievement and intuitive-judging types has led to calls for extra support for sensing types. ■ The use of type in career counselling is widespread and has been used to steer students into 'appropriate' areas of study.	■ Links between type and methods of information processing have not been proved. ■ There is no evidence to suggest that matching teacher and learner types has any positive effects on achievement.
Evidence of pedagogical impact	There is limited evidence to suggest that matching teacher and learner types may increase student affect.	■ Type does not appear to predict performance. ■ The proportion of critical literature, both reviews of the instrument and the resolution of the debate about personality measures in learning styles, has been seen as too low.
Overall assessment	It is still not clear which elements of the 16 personality types in the MBTI are most relevant for education.	
Key source	Myers and McCaulley 1985	

Riding's Cognitive Styles Analysis (CSA)

Table 11
Riding's Cognitive Styles Analysis (CSA)

	Strengths	Weaknesses
General	Learning strategies may be learned and improved.	'Default' learning styles are assumed to be fixed.
Design of the model	Two dimensions which are independent of intelligence: holist-analytic (ways of organising information) and verbaliser-imager (ways of representing information).	■ Two very specific tasks bear the weight of broad and loosely defined constructs. ■ Deals with cognitive, not affective or conative aspects of thinking and learning.
Reliability		■ No evidence provided by the author. ■ Others have shown that internal consistency and test–retest reliability is very poor, especially for the verbaliser-imager ratio score.
Validity	■ Both dimensions have reasonable face validity. ■ The holist-analytic measure may be useful for assessing group rather than individual differences.	■ Performance is sampled over a very limited range of task difficulty. ■ As the reliability of the CSA is so poor, studies of validity should not be accepted unless they have been replicated.
Implications for pedagogy	■ There is evidence of links between cognitive styles and instructional preferences. ■ There is evidence that in computerised instruction, 'holist' learners do better with 'breadth first' and 'analytic' learners with 'depth first'. ■ Riding claims that teachers need to take account of individual differences in working memory as well as style.	■ Most teachers use a variety of instructional approaches anyway (eg verbal and visual). ■ A large number of recommendations are made without adequate empirical evidence.
Evidence of pedagogical impact		Inconclusive.
Overall assessment	The simplicity and potential value of Riding's model are not well served by an unreliable instrument, the CSA.	
Key source	Riding and Rayner 1998	

Sternberg's Thinking Styles Inventory (TSI)

Table 12
Sternberg's Thinking Styles Inventory (TSI)

	Strengths	Weaknesses
General	13 thinking styles are proposed, based on the functions, forms, levels, scope and leanings of government.	■ Why these 13? 13 are too many. ■ Learners self-assess their likely behaviour by responding to statements which are context-free.
Design of the model	Based on a new theory of 'mental self-government'.	■ Sternberg offers a metaphor rather than a theory. ■ No explanation is given as to why some forms of government (eg monarchic) are chosen and not others (eg democratic).
Reliability and validity	Claimed by author to be both reliable and valid.	■ Only limited empirical support for the reliability and validity of the TSI. ■ Scores for reliability considerably lower than those found by author. ■ Little or no support for validity of the TSI.
Implications for pedagogy	■ Teachers to use a variety of teaching and assessment methods. ■ Teachers to be aware of the learning styles they encourage or punish. ■ Teachers to let students know about the range of styles. ■ Teachers to know about gender and cross-cultural differences in styles. ■ Teachers to use extra-curricular activities to enhance quality of teaching and learning.	■ No solid research base for these suggestions, which are logical deductions from the theory. ■ Fifth suggestion stems from research on creativity, rather than learning styles. The advice is of a very general, common-sense nature, most of it known to teachers before any research done on learning styles.
Evidence of pedagogical impact	A series of studies in the US and China have so far produced mixed results.	There is need for independent evaluation.
Overall assessment	An unnecessary addition to the proliferation of learning styles models.	
Key source	Sternberg 1999	

Vermunt's Inventory of Learning Styles (ILS)

Table 13
Vermunt's Inventory of Learning Styles (ILS)

	Strengths	Weaknesses
General	■ It applies to the thinking and learning of university students. ■ New versions in preparation for 16–18 age group and for learning at work. ■ Used for studying the learning styles of teachers and student teachers.	It has little to say about how personality interacts with learning style.
Design of the model	■ It is experientially grounded in interviews with students. ■ It seeks to integrate cognitive, affective, metacognitive and conative processes. ■ It includes learning strategies, motivation for learning and preferences for organising information.	■ It excludes preferences for representing information. ■ It is not comprehensive: there are no items on the control of motivation, emotions or attention. ■ The interpersonal context of learning is underemphasised. ■ Not applicable to all types and stages of learning. ■ Notions of 'constructive' and 'destructive' friction are largely untested.
Reliability and validity	It can be used to assess approaches to learning reliably and validly.	
Implications for pedagogy	■ It is dependent on context, ie a learning style is the interplay between personal and contextual influences. ■ It provides a common language for teachers and learners to discuss and promote changes in learning and teaching. ■ Emphasis not on individual differences, but on the whole teaching–learning environment.	
Evidence of pedagogical impact		■ Little evidence so far of impact on pedagogy. ■ It is not a strong predictor of learning outcomes.
Overall assessment	A rich model, validated for use in UK HE contexts, with potential for more general use in post-16 education where text-based learning is important. Reflective use of the ILS may help learners and teachers develop more productive approaches to learning.	
Key source	Vermunt 1998	

Section 4

Implications for pedagogy

Introduction

This section begins by discussing the various teaching strategies which the developers and advocates of learning style instruments have suggested, with a brief evaluation of the strengths and weaknesses of each. This entry into the world of course developers, institutional managers and front-line practitioners necessarily involves us in a much wider literature than that consulted for the 13 major models evaluated in Section 3.

The sub-sections which follow attempt to answer two questions which are crucial for educational practice.

- Why do some people find learning styles so appealing?
- Why do others find them unacceptable?

We then discuss the lack of research into pedagogy in the UK, particularly compared with Germany; and we offer a brief overview of the different definitions of, and approaches to, pedagogy which have been taken by psychologists, sociologists and adult educators. This section ends with the crucial distinction, drawn by Alexander (2000), between 'teaching' and 'pedagogy'; we argue that the learning styles literature is in the main concerned with the former rather than the latter.

What advice for practitioners?

In the current state of research-based knowledge about learning styles, there are real dangers in commending detailed strategies to practitioners, because the theories and instruments are not equally useful and because there is no consensus about the recommendations for practice. There is a need to be highly selective. As we have seen, for example, in Section 3 with regard to Dunn and Dunn (Table 3), Gregorc (Table 5) and Riding (Table 11), our examination of the reliability and validity of their learning style instruments strongly suggests that they should not be used in education or business. On the other hand, the research of Entwistle (Table 4) and Vermunt (Table 13), which is both more guarded in its claims and built on more solid theoretical foundations, offers thoughtful advice that might, after careful trials and revisions, be extended to post-16 learning outside higher education.

A significant proportion of the literature on the practical uses of learning styles is not, however, so circumspect. Fielding, for instance, goes so far as to argue that an understanding of learning styles should be 'a student entitlement and an institutional necessity' (1994, 393). A thriving commercial industry has also been built to offer advice to teachers, tutors and managers on learning styles, and much of it consists of inflated claims and sweeping conclusions which go beyond the current knowledge base and the specific recommendations of particular theorists. For example, McCarthy (1990) developed what she calls the 4MAT cycle of learning from Kolb's model, and a US website (www. volcano.und.nodak.edu/vwdocs/msh/llc/is/4mat.html) devoted to her approach claims that 'It represents graphically the teacher behaviors appropriate to each stage and style, and provides a framework for planning any lesson or unit, for any age level or content area'.

Some of the leading learning theorists, moreover, make extravagant claims for their model, which reflect badly on the whole field of learning styles research. Rita Dunn, for example, whose approach was evaluated in Sections 2 and 3 (Table 3), is quoted by O'Neil (1990, 7) as claiming that 'Within six weeks, I promise you, kids who you think can't learn will be learning well and easily… The research shows that every single time you use learning styles, children learn better, they achieve better, they like school better.'

In a similar vein, Felder has written articles on the relevance of learning styles to the teaching of science to adults. After examining four different models – the Myers-Briggs Type Indicator, Kolb's Learning Styles Inventory, Herrmann's Brain Dominance Instrument and his own Felder-Silverman instrument – he concludes (1996, 23): 'Which model educators choose is almost immaterial, since the instructional approaches that teach around the cycle for each of the models are essentially identical'. We disagree strongly: it matters which model is used and we have serious reservations about the learning cycle.

For other commentators, the absence of sound evidence provides no barrier to basing their arguments on either anecdotal evidence or 'implicit' suggestions in the research. Lawrence (1997, 161), for instance, does exactly that when discussing the 'detrimental' effects of mismatching teaching and learning styles. More generally, the advice offered to practitioners is too vague and unspecific to be helpful; for example, 'restructure the classroom environment to make it more inclusive rather than exclusive'. The quality of advice given to new post-16 teachers can be gauged by examining one of the leading textbooks (Gray, Griffin and Nasta 2000), where the topic of learning styles is dealt with in three pages. The authors advocate, without justification, Honey and Mumford's four learning styles (see Table 7, Section 3) and then refer their readers to the practical manual on learning styles produced by the Further Education Development Agency (FEDA 1995). Typical of their unproblematic approach to learning styles is the claim that 'a critical part of a carefully-planned induction … is to make an accurate assessment of each student's unique learning styles' (Gray, Griffin and Nasta 2000, 197). In sum, clear, simple, but unfounded messages for practitioners and managers have too often been distilled from a highly contested field of research.

Yet even among critics of research on learning styles, there is a tendency to write as if there was only one monolithic movement which was united in its thinking; in contradistinction, this review has presented a wide spectrum of theoretical and practical positions on a continuum, consisting of five main 'families' or schools of thought. Bloomer and Hodkinson (2000, 584), for instance, argue that 'this literature proposes that learners possess relatively fixed preferences and capacities for learning [and] it seldom explores the extent to which, and the conditions under which, preferences change'. This criticism applies only to those theorists who emphasise deep-seated personal traits at the extreme left-hand side of the continuum (see Figure 4 in Section 3), but is not relevant to the clear majority of learning style theorists who are concerned to improve styles of both learning and teaching. Bloomer and Hodkinson are simply wrong in claiming that most theorists treat learning styles as fixed.

Bloomer and Hodkinson (2000) make, however, a more serious criticism of the learning styles literature to the effect that, even if they are prepared to accept that learning styles exist, they constitute only a minor part of individual dispositions, which influence the reactions of learners to their learning opportunities, which include the teaching style of their teachers. Are these 'dispositions' anything more than Entwistle's 'orientations and approaches to learning' (see Table 4, Section 3); or are they a broader concept? To Bloomer and Hodkinson, dispositions are both psychological and social; by the latter term, they mean that dispositions are constructed by the contexts in which people live and are not simply personal reactions to those contexts. Moreover, these dispositions are said to be wide-ranging in coverage, interrelated in scope and help to explain the strong reactions which many students have to the culture of different educational institutions. (See Ball, Reay and David 2002 for more research on this issue.) Dispositions would appear to be tapping contextual, cultural and relational issues which are not picked up by the learning style instruments of Entwistle or Vermunt.

The strategies which follow are treated separately, but in practice, they tend to overlap and theorists often advocate a judicious selection of approaches rather than an exclusive focus on just one. Furthermore, because we have adopted the stance of treating teaching, learning and assessment as one interactive system, we avoid the temptation to deal with strategies for students separately from strategies for teachers, tutors or managers.

Increase self-awareness and metacognition

A knowledge of learning styles can be used to increase the self-awareness of students and tutors about their strengths and weaknesses as learners. In other words, all the advantages claimed for metacognition (ie being aware of one's own thought and learning processes) can be gained by encouraging all learners to become knowledgeable about their own learning and that of others. According to Sadler-Smith (2001, 300), the potential of such awareness lies in 'enabling individuals to see and to question their long-held habitual behaviours'; individuals can be taught to monitor their selection and use of various learning styles and strategies.

Moreover, as Apter (2001, 306) suggests, an understanding of the various elements which produce different states of motivation in different contexts can 'allow people to come more in control' of their motivation and hence, of their learning. Learners can become more effective as learners if they are made aware of the important qualities which they and other learners possess. Such knowledge is likely to improve their self-confidence, to give them more control over their learning, and to prevent them attributing learning difficulties to their own inadequacies. The upshot could be that students and teachers choose the strategy most appropriate for the task from a 'toolbox of strategies' (Adey, Fairbrother and Wiliam 1999, 30). Kolb (1999, 5) neatly summarises the advantages of this first strategy as follows: 'Understanding your learning style type, and the strengths and weaknesses inherent in that type, is a major step toward increasing your learning power and getting the most from your learning experiences'.

One option is to leave students to diagnose their own learning style so that the responsibility for learning is passed to the learner. But Merrill (2000) argues that most students are unaware of their learning styles and so, if they are left to their own devices, they are most unlikely to start learning in new ways. Herrmann (1989) places some emphasis on the understanding of individual learning styles as a starting place for development, and as a flexible response to life changes and needs, but the popularity of a model can lead to oversimplistic generalisations. For example, the Myers-Briggs Type Indicator, which was intended to enable individuals to explore the interactions of the elements which make up personality – 'type dynamics' – has so far entered popular consciousness that sites exist on the internet advising, for example, ENTP (extrovert, intuitive, thinking and perceptive) individuals as to which other 'types' would make their ideal marriage partners. Hence, the need for dialogue with a knowledgeable tutor who understands the learning styles literature as a whole and has a critical feel for its potential and pitfalls. Such a tutor is likely to pour cold water on, for example, the extravagant claims made by Gregorc (1985) that serious, individual study of learning styles 'will reduce naivete [sic], increase personal responsibility for thoughts and actions, and improve your relationships'.

Serious in-depth study of such matters is not advocated in guidance for new teachers. For example, Huddleston and Unwin (1997, 72) define learning styles as 'study skills and transition from one style of teaching/learning to another'; and advocate, without any explicit rationale (like Gray cited earlier), the use of both Kolb's LSI (Table 9, Section 3) and Honey and Mumford's LSQ (Table 7, Section 3), neither of which are unproblematic, as our earlier evaluations showed.

In these debates, the research of Entwistle (Table 4, Section 3) and Vermunt (Table 13, Section 3) is valuable because, as discussed earlier (section 4), they have shown that attention needs to be given not only to individual differences in learners, but to the whole teaching–learning environment. Both have demonstrated that while the motivations, self-representations, metacognitive and cognitive strengths and weaknesses of learners are all key features of their learning style, these are also a function of the systems in which learners operate. A central goal of their research is to ensure that lecturers can relate concepts of learning to the specific conditions in which they and their students work – that is, it is the whole learning milieu that needs to be changed and not just the learning preferences of individuals.

A lexicon of learning for dialogue

Learning styles can provide learners with a much needed 'lexicon of learning' – a language with which to discuss, for instance, their own learning preferences and those of others, how people learn and fail to learn, why they try to learn, how different people see learning, how they plan and monitor it, and how teachers can facilitate or hinder these processes. Through dialogue with a tutor knowledgeable about the relevant literature, the students' repertoire of learning styles can be enhanced in the hope of raising their expectations and aspirations.

Students can be taught, for instance, which of the 71 learning styles are well founded and which are not, and when and how to choose the most appropriate style. Similarly, tutors can be helped to understand that what they may have been categorising as lazy, unmotivated or truculent behaviour may be caused by a clash in learning styles between themselves and students/colleagues. Even some of the fiercest critics of learning styles concede that a particular test can be safely used 'as a means of facilitating discussion about learning' (Reynolds 1997, 126). As a result, some practitioners use the topic of learning styles simply as a motivational 'ice-breaker', as a means of 'warming up' the class, or as an activity-based introduction to the topic of learning.

For students, particularly those who are less confident about their learning, the acquisition of a new vocabulary which they can use to describe and explore their own behaviour can be an immensely motivating and positive experience and has the potential to help them to reflect and develop their critical thinking. However, this is dependent both on the quality of the experience of using the learning styles instrument and on the nature of the feedback. In this respect, Jackson's LSP (Table 8, Section 3) emerged from our review as a particularly good example of feedback in which traits are described but individuals are not labelled, and the caveat that styles are context-dependent is frequently repeated. Respondents are given areas of strength and weakness to focus on, but are urged overall to consider the goal of the task to be accomplished and to be strategic in their use of their talents.

One of the values of Honey and Mumford's work is that it is primarily aimed, not so much at students in education as at managers and trainers who wish to improve the learning of their staff by means of learning styles. Their *Learning styles helper's guide* (2000) offers a number of suggestions as to how to use their LSQ before, during and after training programmes; for example, to identify training needs, to predict learning difficulties, to constitute groups or teams and to devise and monitor personal development plans. Details are given of the kind of support that managers with predominantly activist, reflective, theorist or pragmatist learning styles can offer their colleagues and staff. Unfortunately, Honey and Mumford (2000) provide no empirical evidence of the effectiveness of these strategies, and we have not found any in the literature.

The recommendation for dialogue, although appealing at first hearing, is not without its difficulties. First, as has become abundantly clear already in this review, there is not one language of learning styles, but a variety of competing vocabularies, with overlapping categories all vying for attention and all dealing with different aspects of teaching; for example, mode of representation, the learning cycle, personality and cognitive processing. So it becomes important to ask: which theorists and which vocabulary are to be chosen and why? Second, the tutors who are to engage in dialogue are very unlikely to be knowledgeable about the vast research literature on learning styles: they may be responsible for hundreds of students whom they meet infrequently and they may use their professional judgement to concentrate on, say, an initiative which sponsors formative assessment, learning identities or thinking skills, rather than one on learning styles.

Third, Roberts and Newton (2001) point to those studies which have shown how difficult, if not impossible, it is at times to teach people to use non-preferred styles or strategies; indeed, many students show considerable resistance to change and their reasons for refusing to change need to be treated with respect. Fourth, problems also arise from the large number of dichotomies (eg verbalisers versus imagers) in the literature. Some theorists do not use these dichotomies as labels of people; for example, Entwistle (see Table 4, Section 3) talks about 'strategic approaches' and not about 'strategic learners'; others, however, are less circumspect (eg Gregorc; Dunn and Dunn). The tendency to label people is rife in the field, but the dialogue we recommend should be based on reason, logic and evidence and on respect for the other in argument.

Career counselling

Theorists of learning style are themselves divided over the issue as to whether their instruments should be used for recruitment, selection and promotion at work, and career counselling more generally. Kolb is very much in favour, Honey and Mumford counsel against the practice, and Allinson and Hayes recommend that companies should select staff for international work according to their learning style. The Myers-Briggs Type Indicator is used extensively in the medical profession to help advanced students to decide on specialist areas of surgery, general practice or research. Kolb (2000, 41) refers to 'strong evidence that certain learning styles characterize certain occupations and groups'; for instance, he claims that teachers have a high orientation towards concrete experience. This finding is explained by Kolb both in terms of people choosing careers congruent with their learning style and then by being shaped by the careers they enter. If there is a mismatch, Kolb predicts that the individual 'will either change or leave the field' (2000, 41).

To help individuals choose an appropriate career, Kolb presents the strengths and weaknesses of each learning style, together with the means of strengthening a style which may not be well developed. So, for example, those who are good at assimilating 'disparate observations into an integrated, rational explanation' are said to be attracted into careers in the physical sciences, biology and mathematics, and in educational research, sociology, law and theology (2000, 43). Kolb also claims that their assimilating skills can be developed by practice in: organising information; building conceptual models; testing theories and ideas; designing experiments; and analysing quantitative data. No empirical data is offered to support these very detailed claims and no explanation is given of how, say, someone with a diverging style who is interested in people and creativity can add the assimilating style to their repertoire by being presented with a list of the skills associated with that style and being invited to practise them.

Matching

One of the most popular recommendations is that the learning styles of students should be linked to the teaching style of their tutor, the so-called 'matching hypothesis'. Much has been written on this topic by learning styles theorists as diverse as Riding, Dunn, Gregorc, Witkin and Myers-Briggs, but the evidence from the empirical studies is equivocal at best and deeply contradictory at worst. Smith, Sekar and Townsend (2002) recently reviewed the evidence and found nine studies which showed that learning is more effective where there is a match and nine showing it to be more effective where there is a mismatch. They concluded (2002, 411): 'For each research study supporting the principle of matching instructional style and learning style, there is a study rejecting the matching hypothesis'. Similarly, Reynolds (1997) marshalled a further five empirical studies in favour of matching and three against, but the matter cannot be settled by a head count.

For instance, Ford conducted three relatively small but rigorous empirical studies of matching and mismatching (1985, 1995; Ford and Chen 2001) and concluded on each occasion that matching was linked with improved performance. His most recent study, however, suggests that the effects of matching and mismatching 'may not be simple, and may entail complex interactions with other factors such as gender, and different forms of learning' (Ford and Chen 2001, 21). We would add another factor which is frequently neglected by the learning theorists: subject matter.

Roberts and Newton (2001) added to this debate by arguing that learning is so complex that it is unlikely to be captured by any set of learning style dichotomies. In particular, they contend that we still do not know how adults discover new learning strategies or how they choose between strategies. Hayes and Allinson also make the point that, even if matching is improving performance, 'it will do nothing to help prepare the learner for subsequent learning tasks where the activity does not match the individual's preferred style' (quoted by Sadler-Smith 2001, 299). One possible conclusion is that it is simply premature (and perhaps unethical) to be drawing simple implications for practice when there is so much complexity and so many gaps in knowledge.

The most telling argument, however, against any large-scale adoption of matching is that it is simply 'unrealistic, given the demands for flexibility it would make on teachers and trainers' (Reynolds 1997, 121). It is hard to imagine teachers routinely changing their teaching style to accommodate up to 30 different learning styles in each class, or even to accommodate four (see sub-section below on teaching around the learning cycle); or responding to the interactions among the 22 elements in the learning style make-up of each student in the Dunn and Dunn approach (see Table 3, Section 3). Four learning styles per class may not be too difficult to achieve during a course of study and the variety would help to provide students with an enjoyable experience; on the other hand, the constant repetition of the learning cycle – for example, beginning every new task with concrete experience – could quickly become tiresome. It must be emphasised that this review has failed to find substantial, uncontested and hard empirical evidence that matching the styles of learner and tutor improves the attainment of the learner significantly.

That finding does not prevent some of the leading developers making extravagant claims for the benefits of matching instruction and the environment with students' learning preferences. Rita Dunn, for instance, claims (1990, 15) that when students have had their learning strengths identified by the Dunn, Dunn and Price LSI:

many researchers have repeatedly documented that, when students are taught with approaches that match their preferences … they demonstrate statistically higher achievement and attitude test scores – even on standardized tests – than when they are taught with approaches that mismatch their preferences.

Yet, as our review of their model showed (see Table 3, Section 3), the research she refers to is highly controversial, and much of it has been sharply criticised for its poor scholarship and for the possible influence of vested interests, because the Dunn centre conducts research into the instrument which it sells (see Kavale and Forness 1990).

One of the few studies outside higher education about the value of matching learner and teacher preferences in instructional style was conducted by Spoon and Schell (1998). It involved 12 teachers and 189 basic skills learners who were working towards a national education diploma. No significant difference in test outcomes was found between congruent groups (where both teachers and learners favoured the same instructional approach) and incongruent groups. As noted previously (see Table 9, Section 3), the 'matching' hypothesis has not been clearly supported. Where positive results are claimed – for example, by Rita Dunn – there are frequently unresolved methodological issues with the studies cited. For example, the training provided by the Dunns goes far beyond the idea of matching instruction to learning style and introduces other systematic and generic pedagogical changes; for example, in lesson structure and in the nature of homework.

Deliberate mismatching

Grasha (1984, 51) asked a pertinent question of matching: 'How long can people tolerate environments that match their preferred learning style before they become bored?'. Vermunt (1998) favours what he terms 'constructive friction', where the teacher pushes students to take more responsibility for the content, process and outcomes of their learning. Apter's research (2001) suggests that frustration or satiation is likely to cause a student to switch between motivational styles and disengage from learning. Grasha's argument is that people need to be 'stretched' to learn and stretching may mean deliberately creating a mismatch between their learning style and the teaching methods. So Grasha's aim (1984, 51) would be 'to teach people new learning styles or at least let them sample unfamiliar ones'. Gregorc's (1984) research supports Grasha's argument in that even those individuals with strong preferences for particular learning styles preferred a variety of teaching approaches to avoid boredom, although this must be set against Gregorc's other assertion (2002) that mismatched learning styles can 'harm' the student. Exhortations to match or mismatch tend to be based on different ideas about the fundamental purposes of education. For Kolb (1984, 203), the educational objectives of mismatching are personal growth and creativity:

the goal is something more than making students' learning styles adaptive for their particular career entry job. The aim is to make the student self-renewing and self-directed; to focus on integrative development where the person is highly developed in each of the four learning modes: active, reflective, abstract, and concrete. Here, the student is taught to experience the tension and conflict among these orientations, for it is from the resolution of these tensions that creativity springs.

The conflict, however, within the literature over mismatching is marked, as can be gauged from the comments of Felder (1993, 289), who drew on empirical studies of college science education in the US:

The mismatching between the prevailing teaching style in most science courses and the learning styles of most of the students have [sic] *several serious consequences. Students who experience them* [sic] *feel as though they are being addressed in an unfamiliar foreign language: they tend to get lower grades than students whose learning styles are better matched to the instructor's teaching style and are less likely to develop an interest in the course material. If the mismatches are extreme, the students are apt to lose interest in science altogether and be among the more than 200,000 who switch to other fields each year after their first college science courses.*

Felder is complaining here about the negative outcomes of unintentional mismatching where, for instance, teachers are unaware of their own learning style and may, as a result, teach only in that style, thus favouring certain students and disadvantaging others. The response to such difficulties, according to Felder (1993, 289), is 'not to determine each student's learning style and then teach to it exclusively', but to 'teach around the learning cycle'. Before turning to that strategy, we wish to stress that deliberate mismatching has the status of an intuitively appealing argument which awaits empirical verification or refutation.

'Teach around the learning cycle' or the 4MAT system

This phrase refers to an eight-step instructional sequence created by McCarthy (1990), which seeks to accommodate *both* preferences for using the two hemispheres of the brain in learning *and* what she considers to be the four main learning styles. Each of these styles asks a different question and displays different strengths.

- *Imaginative* learners who demand to know 'why'? This type of learner likes to listen, speak, interact and brainstorm.
- *Analytic* learners who want to know 'what' to learn. These learners are most comfortable observing, analysing, classifying and theorising.
- *Common-sense* learners who want to know 'how' to apply the new learning. These learners are happiest when experimenting, manipulating, improving and tinkering.
- *Dynamic* learners who ask 'what if?' This type of learner enjoys modifying, adapting, taking risks and creating.

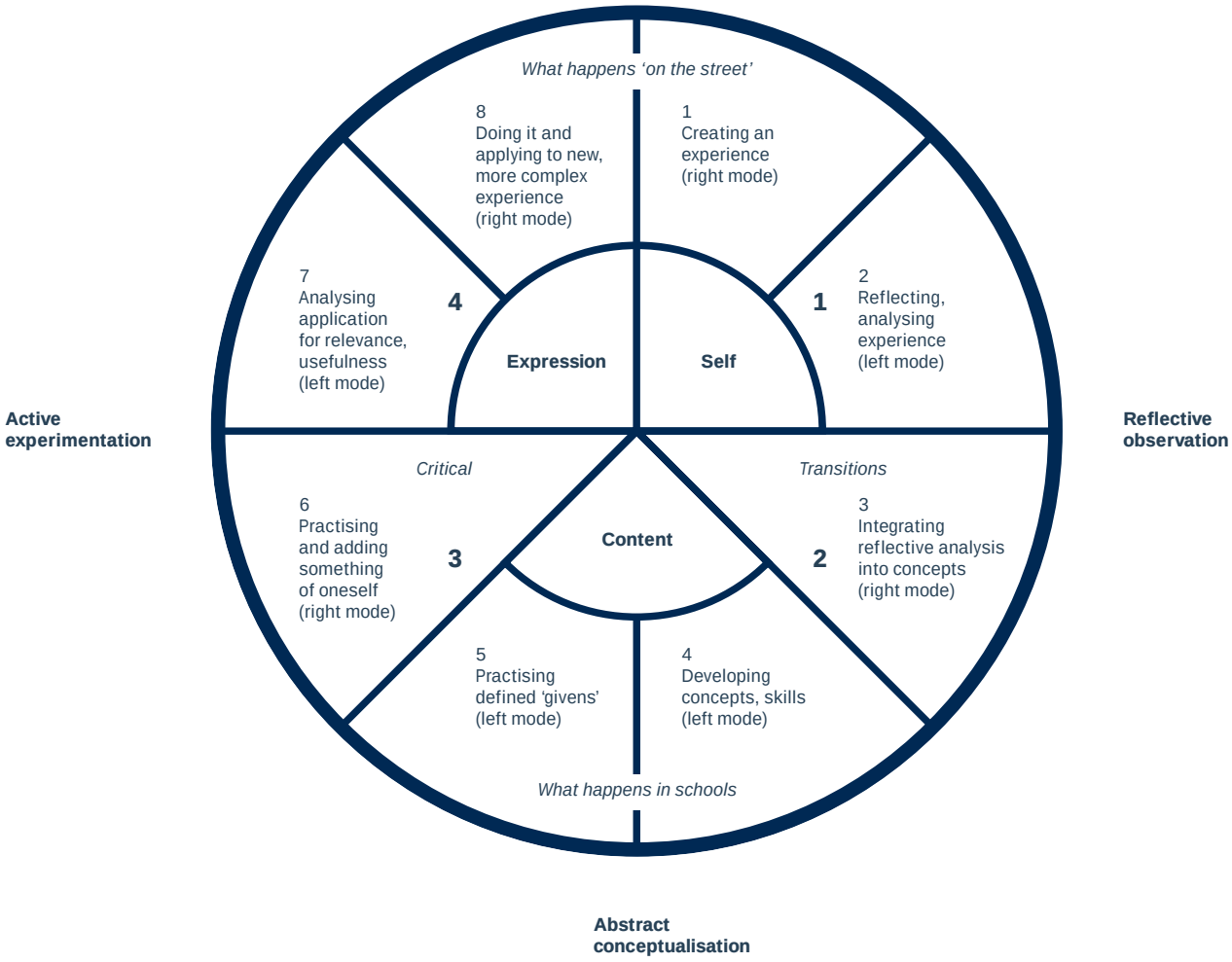
Her 4MAT system uses alternate right- and left-mode techniques of brain processing at all four stages of the learning cycle in order to engage the 'whole brain'. The 4MAT system was designed to help teachers improve their teaching by using eight strategies in a cycle of learning (see Figure 5).

According to McCarthy, 'this cycle appeals to each learner's most comfortable style in turn, while stretching her or him to function in less comfortable modes. The movement around this circle is a natural learning progression' (1990, 33). The latter is simply asserted without evidence. The roles of teachers and students change as they move round the four quadrants. In the first quadrant, the emphasis is on meaning and making connections with the new material to be learned. In the second, the focus is on content and curriculum. The third quadrant is devoted to the practical application and usefulness of the new knowledge; and the final quadrant encourages students to find creative ways of integrating the new knowledge into their lives.

McCarthy claims that when teachers begin to use the 4MAT system, it becomes an agent of change. First, teachers change their attitudes towards diversity among students and see it as a means of enhancing the learning of all types of student and not just the analytic learners who are said to thrive in traditional classrooms. Teachers then begin to realise that teaching involves more than the mere imparting of information and so they begin to use more dialogue and less monologue. Finally, teachers begin to talk to their peers about their teaching and start coaching and mentoring each other.

By 1990, McCarthy had experimented with the 4MAT system in 17 school districts in the US and had come to some wide-ranging conclusions about it. First, her initial plan to focus only on 'instruction', as she calls it, did not work. Paying attention to learning styles led directly to their implications for pedagogy, which immediately raised the question of the curriculum and then the nature of assessment. In these practical applications, McCarthy recognised the potential of the 4MAT process to act as a systems approach to change, not only for learning styles, but also for the curriculum, assessment and staff development more generally.

Figure 5
The 4MAT system
Source: McCarthy (1990)



Advertisements for the 4MAT system are not, however, reserved about its benefits; for example: 'By teaching to all types of learners with each lesson, teachers can reach learning potentials in their students never before realized'. The developers of such systems should take some responsibility for the advertisements which promote their wares, but they cannot be held responsible for the excesses of some of their supporters. For example, Kelley, a director of human resources, chose to use the 4MAT system to integrate innovations in teaching and curriculum in public schools in Colorado; she predicted (1990, 39) that 'learning styles knowledge will enable us to make a major paradigm shift in assessment'. She also used McCarthy's work to label students, categorising work as that which is 'easy for a Quadrant Four learner, but harder for the Quadrant Two and Quadrant Three learners' (1990, 38). In the US, you can, for a fee, be helped to design and produce your own learning style instrument.

The 4MAT system has been extensively used, particularly in the US, with a wide variety of students from pre-school children to adults attending evening classes, and with a broad range of subject matter from elementary music to college courses in psychology. The approach is now generating its own literature, with the 4MAT website (www.aboutlearning.com) listing, in 2002, 43 articles and 38 doctoral theses exploring the use of the model with students or in staff development. McCarthy, St Germain and Lippitt (2001) conclude that most of these studies report positive experiences in applying 4MAT; that a few are less enthusiastic because of the low tolerance of tutors for change; and that teachers 'often have great difficulty in implementing change because the old ways are so comfortable and teachers tend to feel guilty if they are not at the front of the classroom giving information' (2001, 5).

The theoretical base for the 4MAT system is the work of Kolb. For Kolb, the learning cycle is a diagrammatic representation of his experiential learning model – how experience is translated into concepts which are then used to guide the choice of new experiences. Kolb (1999, 3) is adamant that all four phases of the cycle are necessary for effective learning, but concedes that 'different learners start at difference places in this cycle'. It needs to be remembered, however, that the statistical analyses of Wierstra and de Jong (2002) have seriously questioned the structure of Kolb's model on which the learning cycle is based (see Table 9, Section 3 for evaluation).

In a recent article, Honey (2002) has explained why he too is 'besotted' with the learning cycle. He gives three main reasons. First, Honey argues, without producing any evidence, that the cycle describes the essential ingredients of the process of learning so that it can be analysed and improved. Second, the cycle, it is asserted, helps people to identify where their learning weaknesses lie and so encourages them to move outside their 'preference zone'. Finally, 'the learning cycle is a vehicle for making learning explicit and therefore communicable' (2002, 115). In other words, Honey always uses the learning cycle to stimulate discussion about learning. These claims have intuitive appeal but await empirical verification.

Logical deductions from theories of learning style

One characteristic of most of the advice offered to practitioners is that it consists of logical deductions from the various theories of learning style rather than of conclusions drawn from the findings of empirical research. Such advice tends *either* to be of a very general nature – for example, Sternberg (1999) urges teachers to use a variety of teaching and assessment methods; *or* to be rather specific tips for particular types of teacher – for example, Felder (1996, 22) encourages science teachers to 'use physical analogies and demonstrations to illustrate the magnitudes of calculated quantities'. Another type of detailed advice is offered by advocates of the Dunn and Dunn model, who prescribe not only techniques for imparting information, but also the design of learning environments, including furniture, lighting, temperature, food and drink, sound, etc.

The one implication for practice which is repeated throughout the literature on learning styles is that it is the responsibility of teachers, tutors and managers to adapt their teaching style to accommodate the learning style of their students or staff members. But such an unqualified exhortation is both unhelpful and unrealistic, because it could be interpreted as meaning that the teacher/tutor/manager is obliged to respond appropriately to visual and verbal learners (and perhaps ***haptic*** learners also); to ***inductive*** and ***deductive***, reflective and active, sequential and global, conceptual and concrete learners; and to those who like working in groups as well as those who prefer learning individually. Despite the strong convictions with which these ideas are promoted, we failed to find a substantial body of empirical evidence that such strategies have been tried and found successful. Advice of this type strikes practitioners as unworkable and so it tends to remain untested.

There has been some focus on the idea that some 'types' make more successful teachers or managers, though some of these measures – eg field independence – tend to be correlated to ability (Tinajero and Paramo 1997) and for others, evidence regarding the connection between the construct (intuition in entrepreneurs) and career advancement is contradictory (Armstrong 2000). Moreover, those theorists who tend to favour the idea that learning styles are fixed rather than flexible should concede that the styles of the teachers may also be resistant to change and that the styles adopted by powerful figures at work may be shaped by social, cultural and political factors which go beyond individual differences.

Change teaching styles

The topic of teaching styles has its own literature, theorists and controversies, but it is beyond the remit of this review and so will not be explored. It is sufficient here to refer to the myriad interactions between the learning style of the student and the objectives, content, sequence, teaching methods and social context of the lesson. Merrill (2000) proposed that these more fundamental teaching strategies should take precedence over learning styles, which should then be used to 'fine-tune' the teacher's plans. The metaphor of slightly adjusting an engine to make it run more efficiently seems singularly inappropriate to the current state of knowledge of learning styles.

To borrow a metaphor from the Roman poet Horace, has the mountain of research on learning styles gone into labour and produced a ridiculous mouse, or has it brought forth new ideas for a more professional practice based on learning styles? In our opinion, the critics who dismiss all the practical consequences of learning styles research as either trivial or 'old hat' are missing opportunities for professional growth and institutional change, but we leave it to the reader to judge whether all the resources and energies which have been invested in learning styles have produced an adequate return.

The appeal of learning styles

For some, learning styles have become an unquestioned minor part of their professional thinking and practice, which allows them to differentiate students quickly and simply; for others, the same instruments are considered both unreliable and invalid and so they do not use them in practice; for others still, learning styles are the central doctrine in a quasi-evangelical crusade to transform all levels of education. Such a broad range of responses to and uses of learning styles is only to be expected. What we attempt to do now is to summarise the reasons why so many practitioners have become 'converted' to their use.

- Some of the learning style literature promises practitioners a simple solution to the complex problems of improving the attainment, motivation, attitudes and attendance of students. In an audit culture where professionals and institutions are held responsible for the attainment and behaviour of their students, it is little wonder that teachers and managers are prepared to try new techniques which claim to help them meet their targets more easily. It is probably not an exaggeration to say that much of the development and marketing of learning style instruments has been driven by the needs of practitioners in education and business, rather than by the needs of learning theorists (see Cassidy 2003).
- Many practitioners have long since discovered for themselves that traditional methods (of transmission by teacher and assimilation by student) fail many students, and the learning style literature provides a plausible explanation for such failure. The modern cliché is that the teacher may be teaching, but no one – not even the teacher – may be learning. The argument of many learning style developers is that traditional, formal schooling (and higher education even more so) are too biased towards students who are analytic in their approach, that teachers themselves tend to be analytic learners, and that the longer people stay in the education system, the more analytic they become. They argue further that learning styles provide a means whereby the diverse learning needs of a much broader range of students can be addressed. In other words, many teachers tend to respond well to the invitation to examine their own teaching and learning style; and the hope of the theorists is that by doing so, they will become more sensitive to those whose learning style is different.
- Because of a growing interest in learning styles, teachers and managers begin, perhaps for the first time, to explore the highly complex nature of teaching and learning. In the pedagogical triangle of teacher, students and subject, the learning styles approach trains professionals to focus on how students learn or fail to learn. When, or if, this happens, what some now see as the overemphasis on providing, for example, student teachers with an understanding of how particular subjects (English, mathematics, science, etc) are most appropriately taught may begin to be corrected. The corrective may, however, create its own imbalances: what is needed is equal attention to all parts of the triangle and their interactions. The danger is that we end up with content-free pedagogy, where process is celebrated at the expense of content.
- For some learning style developers, there is no special category of students with learning difficulties, only teachers who have not learned that their teaching style is appropriate for perhaps a quarter of their students and seriously inappropriate for the remainder. Those teachers who have incorporated the Dunn and Dunn model into their practice speak movingly at conferences of how this re-categorisation of the problem (where students' failure to learn is reformulated as teachers' failure to teach appropriately) has transformed their attitude to students they previously dismissed as stupid, slow, unmotivated, lazy or ineducable. This is not an inconsiderable achievement.
- It is not only front-line practitioners and middle managers who have been persuaded of the benefits of introducing learning styles. For some senior managers, for inspectors, for government agencies, policy-makers and politicians, the appeal of learning styles may prove convenient, because it shifts the responsibility for enhancing the quality of learning *from* management to the individual learning styles of teachers and learners. Learning styles enable the more managerialist and cynical to argue as follows: 'There's no longer any need to discuss resources, financial incentives, pay and conditions, the culture of institutions, the curriculum, the assessment regime or the quality of senior management: the researchers now tell us that failure can be laid at the door of those narrow, analytic teachers who've never heard of learning styles.'

The objections to learning styles

The critics of learning styles can be divided into two main camps. First, there are those who accept the basic assumptions of the discipline (eg the positivist methodology and the individualistic approach), but who nevertheless claim that certain models or certain features within a particular model do not meet the criteria of that discipline. A second group of critics, however, adopts an altogether more oppositional stand: it does not accept the basic premises on which this body of research, its theories, findings and implications for teaching have been built. As all the other sections of this report are devoted to a rigorous examination of 13 models of learning styles within the ***parameters*** set by the discipline itself, this sub-section will briefly explain the central objections raised by those hostile to the learning styles camp, who mutter at conferences in the informal breaks between presentations, who confide their reservations in private, but who rarely publish their disagreement. We wish to bring this semi-public critique out into the open.

- The opponents, who are mainly those who espouse qualitative rather than quantitative research methods, dispute the objectivity of the test scores derived from the instruments. They argue, for example, that the learning style theorists claim to 'measure' the learning preferences of students. But these 'measurements' are derived from the subjective judgements which students make about themselves in response to the test items when they 'report on themselves'. These are not objective measurements to be compared with, say, those which can be made of the height or weight of students, and yet the statistics treat both sets of measures as if they were identical. In other words, no matter how sophisticated the subsequent statistical treatments of these subjective scores are, they rest on shaky and insecure foundations. No wonder, say the sceptics, that learning style researchers, even within the criteria laid down by their discipline, have difficulty establishing reliability, never mind validity.

  Respondents are also encouraged to give the first answer which occurs to them. But the first response may not be the most accurate and is unlikely to be the most considered; evidence is needed to back the contention that the first response is always the one with which psychologists and practitioners should work.

- The detractors also have reservations about some test items and cannot take others seriously. They point, for example, to item 65 in Vermunt's ILS (see Table 13, Section 3) which reads: 'The only aim of my studies is to enrich myself.' The problem may be one of translation from the Dutch, but in English, the item could refer to either intellectual or financial enrichment and it is therefore ambiguous. Or they single out the item in Entwistle's ASSIST (see Table 4, Section 3) which reads: 'When I look back, I sometimes wonder why I ever decided to come here.' Doesn't everyone think this at some stage in an undergraduate course?

  Others quote from the Dunn, Dunn and Price PEPS instrument (see Table 3, Section 3), the final item of which is 'I often wear a sweater or jacket indoors'. The answers from middle-class aesthetes in London, who prefer to keep their air-conditioning low to save energy, are treated in exactly the same way as those from the poor in Surgut in Siberia, who need to wear both sweaters and jackets indoors to keep themselves from freezing to death. What, ask the critics, has this got to do with learning and what sense does it make to ignore the socio-economic, cultural and even geographic context of the learner?

  Those who simply wish to send up the Dunn, Dunn and Price LSI for 6–18 year olds reveal that it contains such items as: 'I like to do things with adults'; 'I like to feel what I learn inside of me'; and 'It is easy for me to remember what I learn when I feel it inside me.' It is no surprise that some psychologists argue that criticism should not be directed at individual items and that one or two poor items out of 100 do not vitiate the whole instrument. Our response is that if a few items are risible, then the instrument may be treated with scorn.

- Other opponents object to the commercialisation of some of the leading tests, whose authors, when refuting criticism, are protecting more than their academic reputations. Rita Dunn, for example, insists that it is easy to implement her 22-element model, but that it is also necessary to be trained by her and her husband in a New York hotel. The training course in July 2003 cost $950 per person and lasted for 7 days at a further outlay of $1384 for accommodation. The cost of training all 400,000 teachers in England in the Dunn methodology would clearly be expensive for the government, but lucrative for the Dunns.

- Some opponents question what they judge to be the unjustified prominence which is now accorded to learning styles by many practitioners. Surely, these academics argue, learning styles are only one of a host of influences on learning and are unlikely to be the most significant? They go further by requesting an answer to a question which they pose in the terms used by the learning style developers, namely: 'What percentage of the variance in test scores is attributable to learning styles?' The only direct answer to that question which we have found in the literature comes from Furnham, Jackson and Miller (1999), who study the relationship between, on the one hand, personality (Eysenck's Personality Inventory) and learning style (Honey and Mumford's LSQ); and on the other, ratings of the actual performance and development potential of 200+ telephone sales staff: 'the percentage of variance explained by personality and learning styles together was only about 8%' (1999, 1120). The critics suggest that it is perhaps time that the learning style experts paid some attention to those factors responsible for the other 92%.[4]
- Others seek to disparage the achievements of research into learning styles by belittling what they call the rather simple conclusions which emanate from the increasingly elaborate statistical treatment of the test scores. Their argument can be summarised and presented as follows:

  For more than 40 years, hundreds of thousands of students, managers and employees have filled in learning style inventories, their scores have been subjected to factor analyses of increasing complexity, numerous learning styles have been identified, and what are the conclusions that stem from such intensive labour? We are informed that the same teaching method does not work for all learners, that learners learn in different ways and that teachers should employ a variety of methods of teaching and assessment. Comenius knew that and more in seventeenth century Prague and he did not need a series of large research grants to help him find it out.

  This is, of course, high-flying hyperbole, but we leave our readers to judge the accuracy of this assessment after they have read the following section.

Still no pedagogy in the UK

According to Dewey (1916, 170), pedagogy is often dismissed as futile because: 'Nothing has brought pedagogical theory into greater dispute than the belief that it is identified with handing out to teachers recipes and models to be followed in teaching'. Earlier, in 1897, while working in the University of Chicago in a combined department of philosophy, psychology and pedagogy, Dewey had issued *My pedagogic creed* in which he expressed his belief that 'education must be conceived as a continuing reconstruction of experience' (1897, 53) and that 'the teacher is engaged, not simply in the training of individuals, but in the formation of the proper social life' (1897, 59). Dewey's famous essay proved to be an inspiration to Kolb; it can also be read as a hymn to the dignity of the teacher's calling and to the importance of education as 'the fundamental method of social progress and reform' (1897, 57).

In the century that has passed since these stirring words were written, it is surprising how the concept of pedagogy has remained relatively unexplored and untheorised in the English-speaking world. In the 1980s, Simon felt obliged to ask the very pertinent question: 'Why no pedagogy in England?' According to Simon, 'the most striking aspect of current thinking and discussion about education is its eclectic character, reflecting deep confusion of thought, and of aims and purposes, relating to learning and teaching – to pedagogy' (reprinted 1999, 34).

The truth is that the widespread eclecticism and deep confusion which Simon complained of continue to dog pedagogical practice in England and elsewhere in the English-speaking world. As recently as 1996, Anthea Millett, then chief executive of the Teacher Training Agency (TTA), was making the charge that pedagogy was 'the last corner of the secret garden' and continued to be neglected; but as Alexander has pointed out, 'her real message was not about pedagogy at all: it was about performance management and teachers' need to comply with government thinking' (2000, 542).

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It has not been possible to answer the question 'What proportion of the variance in achievement outcomes is attributable to learning style?' because we only found one reasonably relevant study – Furnham, Jackson and Miller (1999). There is a considerable body of research in which measures of prior achievement, ability, motivation and personality have been evaluated as predictors of university first-degree performance, but we have found none in which learning styles have been considered as well. Information about the prediction of learning outcomes in post-16 education and training outside higher education is relatively sparse, but again, there is no work in which learning styles have been compared with ability measures as predictors.

In general, it can be said that no powerful predictors of learning in higher education have been identified by any researchers, since the proportion of variance accounted for in large-scale studies rarely exceeds 16%, no matter how many characteristics of learners are considered.

There is one apparent exception to the above generalisation. Drysdale, Ross and Schulz (2001) carried out one of the largest predictive studies we have found in a university context, but in that study, only learning style was used as a predictor of first-year academic performance. The effect sizes were substantial for mathematics, science and technology subjects, with Gregorc's sequential style students outperforming those with a random style. The reverse was true in fine arts, but no differences were found in the liberal arts or in nursing. This result is hard to understand, in view of the problems we have identified with Gregorc's Style Delineator (see Table 5, Section 3). We recommend that similar studies be carried out with a variety of learning style instruments, but adding in other predictors. The Herrmann and Jackson instruments (Tables 6 and 8, Section 3) would be suitable for this purpose.

The history of pedagogy in the UK is bedevilled by the fact that practitioners and researchers work with markedly different definitions and models of pedagogy from within the separate disciplinary perspectives of adult education, psychology and sociology. In addition, there are substantial differences in the pedagogical language and theories used in further and adult education, in higher education and in work-based training; and there is very little interaction between these differing approaches. In short, as Zukas and Malcolm argue; 'Lifelong learning pedagogies do not, as yet, exist in the UK' (2002, 203).

Into the theoretical and moral vacuum created by the lack of one generally accepted theory of pedagogy in the post-16 sector (or any other sector, for that matter) have moved official models of pedagogy of a particularly instrumental kind. The DfES Standards Unit, the inspectorates and the curriculum and awarding bodies all, in their different ways, interpret pedagogy as the unproblematical application of apparently neutral, value-free techniques, which they have accorded the status of 'best practice', without always making clear the evidential basis for their claims. In such a climate, the use of learning styles as a diagnostic assessment or as a means of differentiating students is presented to practitioners or student teachers as the uncomplicated equivalent of other injunctions about what constitutes 'best practice', such as 'facilitate learning in groups' or 'set precise targets with individual learners'.

Differing definitions and models of pedagogy

Within the general literature of education, definitions of pedagogy abound, but they can be placed on a continuum, from definitions which concentrate narrowly on teaching techniques to those which deal with broader issues such as the significance of culture, power, social structure and identity. The treatment of pedagogy in the learning styles literature leans heavily towards psychological rather than sociological definitions of the term. For example, when Kolb, a psychologist, is discussing the implications of his research for 'training design', he envisages the following four roles for the teacher, whom he prefers to call the 'facilitator' – communicator of information, guide or taskmaster, coach or helper, and role model (2000, 17). Zukas and Malcolm (2002), who are both adult educators working within a different paradigm, identified in the literature the five pedagogic roles of assurer of quality and efficiency, facilitator of learning, reflective practitioner, critical practitioner and situated learner within a community of practice. It is fascinating that, when both are discussing the main identities of the teacher, the two approaches have only one role in common, namely, the facilitation of learning.

Rather surprisingly, Simon was content to use *The Oxford English Dictionary*'s definition of pedagogy as 'the science of teaching' (1999, 39), which suggests a concern to establish the general principles of teaching and learning. But for adult educators such as Zukas and Malcolm (2002, 215), pedagogy is not primarily concerned with a well-developed repertoire of teaching skills, but with:

a critical understanding of the social, policy and institutional context, as well as a critical approach to the content and process of the educational/training transaction … the most important elements of pedagogy are the relations between educator, student and institution, the social context, purpose and ethical implications of educational work, and the nature and social role of educational knowledge

Leach and Moon (1999, 268), clearly influenced by Lave and Wenger (1991), go further in arguing that pedagogy should be concerned with the construction and practice of learning communities:

Pedagogy is more than the accumulation of techniques and strategies: arranging a classroom, formulating questions, developing explanations, creating a curriculum. It is informed by a view of mind, of learning and learners, of the kind of knowledge that is valued and above all by the educational outcomes that are desired.

The literature is replete, however, not only with different definitions, but also with a variety of models of pedagogy and approaches to it. The range extends from those adopted by cognitive psychology (eg Eggen and Kauchak 2001), to sociology (Bernstein 1996), workplace learning (Fuller and Unwin 2002) and adult education (Boud 1989). Teachers, tutors and managers working in the post-16 sector are likely to have been influenced to varying degrees by these different traditions, research interests, theoretical frameworks and languages; and yet these are the groups which remain to be convinced that learning styles have important implications for their pedagogy. In the absence of an explicit, coherent and agreed theory of pedagogy, any attempt to convince practitioners of the usefulness of learning styles will have to take account of these conflicting and implicit traditions in different sectors within post-16 learning.

This report is not, however, the place to provide *either* an introduction to the vast literature on teaching and learning in the post-16 sector *or* a detailed explanation of all the various traditions within pedagogy in the UK which have relevance for post-16 learning. That would amount to another research project, which would examine the history, the theory, the practice and the current status of humanistic pedagogy, critical pedagogy and andragogy (the teaching of adults), to mention but three. Instead, we outline briefly two significant contributions: one from psychology (that of Jerome Bruner) and one from sociology (that of Basil Bernstein), which have yet to be integrated into one comprehensive socio-psychological theory of pedagogy.

Bruner's main argument (1996) is that educational reform necessarily involves changing the folk pedagogical theories of not just teachers, but also of students. The significance of Bruner's contribution is that he shifts the focus from different types of learning style to four alternative models of the minds of learners. To Bruner, it matters profoundly whether teachers see students as *either* empty receptacles to be filled with propositional knowledge; or as apprentices in thinking who acquire 'know-how' through imitation; or as sophisticated knowers who grasp the distinction between personal and objective knowledge; or as collaborative thinkers who can learn through participation how their own and other people's minds work. Bruner wants all 'four perspectives to be fused into some congruent unity' and wants all teachers and students to become more metacognitive, to be as aware of how they go about teaching and learning as they are about the subject matter. In his own words, improvements in pedagogy are predicated on teachers and students understanding the minds of learners and on 'getting teachers (and students) to think *explicitly* about their folk psychological assumptions, in order to bring them out of the shadows of tacit knowledge' (1996, 47; original emphasis). A pressing issue for this review is whether it would be more beneficial for the quality of learning in the post-compulsory sector to recommend that Bruner's advice be followed, rather than administering a learning styles instrument to a group of students and then discussing the outcomes with them.

In contrast to the work of, for example, so many learning style theorists who are concerned with the implications of the various styles for methods of instruction, Bernstein (1996) sought to make connections between the macro structures of power and control within society and the micro processes within schools that generate practices of inclusion and exclusion. In Bernstein's quest to create a new sociology of pedagogy, he showed how different knowledges are differentially distributed to different social groups and how, within educational institutions, some students are valued, while the 'voices' of others remain unheard.

According to Edwards (2002, 530), Bernstein was particularly critical of:

[the] *classroom researchers' habit of detaching teacher-pupil interactions from structures of power and control in which they are embedded. In his model, pedagogy was much more than the transmission of a curriculum. It covered the structure and categories of school knowledge, what can be said and written 'legitimately' under its various headings, how specifically or diffusely the required learning outcomes are assessed, and how different education codes relate to modes of production and to pupils' anticipated occupational futures.*

A striking feature of the British research on learning styles is its lack of engagement both with structures of power and with deeper structural inequalities. There exists, for example, no extensive research in the UK on learning styles and social class, or on learning styles and ethnicity. One of the few learning styles researchers to take account of contextual influences is Entwistle (see Table 4, Section 3), but even he limits his coverage to the immediate influences of course design and neglects the problems of unequal access to the knowledge and skills needed to become a successful learner.

While we await a fusion of these two approaches to pedagogy in psychology and sociology, the comparative studies of Alexander (2000) constitute, in our opinion, the most compelling explanation of how, in different countries and within any one country, history, culture and teaching come together to create very different pedagogies.

So, for example, in Germany, staff in education departments, when teaching pedagogy, draw on the historical, theoretical contributions of Kant, Herbart, Froebel and Pestalozzi, as well as such modern theorists as Harmut von Hentig, Dietrich Benner and Elmar Tanorth. In other words, German pedagogy is a well-established and respected intellectual tradition which is divided into nine sub-disciplines (eg *Schulpädagogik*, *Sonderpädagogik* or pedagogy of special education, *Berufs/Wirtscharftspädagogik* or pedagogy of vocational education), 10 subject specialisms (eg *Sexualpädagogik*, *Umweltpädagogik* or environmental pedagogy, and *Interkulturelle Pädagogik*), and seven practical areas (eg management education, *Gesundheitserziehung* or health education, and *Friedenserziehung* or peace education) – see Lenzen (1989) for a full explanation of the *Struktur der Pädagogik*. Beneath all of these come the *Fachdidaktiken* – that is, the teaching methods for all the subject disciplines of mathematics, history, chemistry and so on, which German students of education study in the relevant university department.

The contrast with the UK, where there is still no reputable and honoured tradition of pedagogical research and thinking, could hardly be more marked. Recently, however, a start has been made by Alexander who concluded his monumental study (2000) by proposing a useful distinction between teaching and pedagogy and, in doing so, pressed into service the sociological term 'discourse', which Ball (1994, 21) defined as follows: 'Discourses are about what can be said, and thought, but also about who can speak, when, where and with what authority'. Alexander is keen to differentiate the two terms 'teaching' and 'pedagogy' in order to discourage their interchangeable usage in the UK:

*teaching is an **act** while pedagogy is both act and **discourse**. Pedagogy encompasses the performance of teaching together with the theories, beliefs, policies and controversies that inform and shape it… Pedagogy connects the apparently self-contained act of teaching with culture, structure and mechanisms of social control.*
(2000, 540; original emphasis)

It is our contention that most of the models of learning styles have so far confined themselves to teaching and only a few of the best have even begun to address pedagogy.

Section 5

Recommendations and conclusions

Introduction

This report began with an overview of the challenges presented by the nature of the research into learning styles. These challenges meant that this report had to:

- evaluate the main theories about learning styles for academic, policy-making and practitioner audiences
- select the most important studies from an extensive literature
- assess the theoretical robustness of each model and the psychometric quality of the accompanying instrument used to measure learning styles
- evaluate the implications of these models for pedagogy in different post-16 contexts.

In addressing these challenges, the research team combined expertise in cognitive psychology, education, the professional development of post-16 practitioners, sociology and policy studies. The team approach has enabled us to produce a report based on robust, internal critique of draft sections and regular discussions of our different perspectives on the main issues raised by the review. An important aim from the outset was to extend debate about learning styles from the specialist discipline of cognitive psychology and to locate claims for learning styles in the social and political context of the learning and skills sector. A concomitant aim was to go beyond a merely technical discussion of teaching and learning styles as a set of unproblematic techniques for teachers to apply and to show that pedagogy itself is a much broader, complex and contested notion.

This final section draws directly on the evidence and arguments presented earlier in this review. Here we:

- present nine problems which continue to beset the research field of learning styles
- indicate the major gaps in the current state of knowledge which could form the basis of future research projects
- make some final comments about the prospects for learning styles.

First, though, we want to begin by stressing the valuable features which have emerged from our close reading of the literature. We wish to offer some positive recommendations for the LSDA and other agencies to consider.

Positive recommendations

We wish to start this section by acknowledging the beneficial uses of those models which have proved to be the most psychometrically sound and ecologically valid. We agree with Entwistle (1990, 676) that the primary professional responsibility of teachers and trainers is to maximise the learning opportunities of their students or staff and that 'We should surely not leave effective study strategies to evolve through trial and error when we are now in a position to offer coherent advice'.

Self-awareness and metacognition

A reliable and valid instrument which measures learning styles and approaches could be used as a tool to encourage self-development, not only by diagnosing how people learn, but by showing them how to *enhance* their learning. As Garner (2000) has argued, self-development is more likely to result from increasing learners' knowledge of the relative advantages and weaknesses of different models, than from learners being assigned a particular learning style. One of the main aims of encouraging a metacognitive approach is to enable learners to choose the most appropriate learning strategy from a wide range of options to fit the particular task in hand; but it remains an unanswered question as to how far learning styles need to be incorporated into metacognitive approaches.

Desmedt *et al.* (2003, 147–148) have begun to question why and how an awareness of one's learning style should be thought to have a positive effect on the quality of one's learning. They conclude that learning style awareness is only a 'cog in the wheel of the learning process' and that 'it is not very likely that the self-concept of a student, once he or she has reached a certain age, will drastically develop by learning about his or her personal style'.

Despite reservations about their model and questionnaire (see Table 7, Section 3), we recognise that Honey and Mumford have been prolific in showing how individuals can be helped to play to their strengths or to develop as all-round learners (or both) by means, for example, of keeping a learning log or of devising personal development plans; they also show how managers can help their staff to learn more effectively. *We wish to recommend that consideration be given to developing for schools, colleges, universities and firms new programmes of study focused on human learning and how it can be fostered*.

Our recommendation in favour of increased self-awareness should not, however, be interpreted as support for more individualised instruction, as Kolb (1984) has argued. The benefits of individualised teaching are often greatly exaggerated, although many teachers will admit that it is extremely difficult to ensure that learners are benefiting from specially tailored approaches when there is a large class to manage. In a synthesis of 630 studies, Hattie (1992) found an average effect size of only 0.14 for individualised teaching in schools. This trivial result strongly suggests that in general, it is not a good use of teacher time to try to set up, monitor and support individual learning programmes where there are large groups to deal with. It should be noted that the potential of ICT to support individualised instruction has not been fully evaluated. However, the key point is that individualised instruction is not likely to work if it means more unsupported individual learning. Whether or not skilled individual or small-group teaching support can improve the situation is an unanswered question, but the near zero mean effect size for team teaching (also reported by Hattie) does not provide grounds for optimism. Within post-16 learning, the extent to which tutors can offer individualised programmes varies considerably. Individualisation is both more appropriate and easier to organise, for example, in an evening class on tailoring than in an A-level history class.

A lexicon of learning for dialogue

On the grounds of robustness and ecological validity, *we recommend that the concepts developed by Entwistle* (Table 4, Section 3) and others, of deep, surface and strategic approaches to learning, and by *Vermunt* (Table 13, section 3) of meaning-directed, application-directed and reproduction-directed learning styles, *be adopted for general use in post-16 learning rather than any of the other competing languages*. It needs to be remembered, however, that the instruments were designed for university students and need to be redesigned to fit the extremely wide range of contexts within post-16 learning. The potential and pitfalls of creating a dialogue with students about, say, the implications of adopting a surface approach to learning have been discussed in detail in Section 4. Here we simply want to reiterate that the tutors/trainers who involve their students/staff in dialogue need to be knowledgeable about the strengths and limitations of the model they are using; to be aware of the dangers of labelling and discrimination; and to be prepared to respect the views of students who may well resist any attempts to change their preferred learning style. In a project designed to put the concepts of 'teaching thinking' and 'metacognitive awareness' into practice, Leat and Lin (2003) found that having a language to describe the new pedagogy and specific roles for teachers to experiment with were critical to success.

If this recommendation is adopted, some formidable barriers will need to be overcome; for example, ACE tutors, work-based trainers and college lecturers will need a different form of initial teacher training and staff development to enable them to explore critically the more promising models and instruments. Similarly, middle and senior managers throughout the learning and skills sector will need a critical understanding of learning styles and how dialogue about learning between tutors and students can lead to wider institutional change. Management skills need to be expanded from an understandable concentration on finance and accountability to embrace a critical understanding of the central role of teaching and learning in the reform of post-16 education and training.

Pedagogy on its own is not enough

Both McCarthy (1990) and Entwistle and Walker (2000) have spotted the potential of learning styles to act as an agent for broader change. Open-ended dialogue between tutor and students may begin by identifying forms of support such as courses on study skills and, with a tutor alive to the possibilities of growth, it should lead on to a discussion of the curriculum and assessment. If this in turn encourages tutors to discuss among themselves how they can improve students' approaches to learning, then the door is open for course teams, initial teacher trainers and continuing professional developers to use the topic of learning as a springboard for broader cultural change within the organisation. What may begin as a concern to respond more appropriately to variation in patterns of students' learning may provoke a re-assessment of the goals of education or training, the purposes of assessment and the relevance of certain aspects of the curriculum. If learning styles are to be used to improve practice, *we recommend that they are employed in the hope that an exploration of pedagogy may well usher in far-reaching change*. As Leat and Lin comment (2003, 410): 'as teachers become more confident in their practice so they are more likely to demand access to school policies and procedures'.

The positive recommendation we are making is that a discussion of learning styles may prove to be the catalyst for individual, organisational or even systemic change. We also want, however, to stress the limitations of an approach which may restrict itself to changes in teaching techniques; for, as Lave and Wenger (1991, 100) have argued, the most fundamental problems of education are not pedagogical:

Above all, they have to do with the ways in which the community of adults reproduces itself, with the places that newcomers can or cannot find in such communities, and with relations that can or cannot be established between these newcomers and the cultural and political life of the community.

Professional choice – which intervention to choose?

Before making any change in practice, professionals are duty-bound to consider two possibilities: first, that the proposed change may make matters worse; and second, that some alternative change may be more beneficial than their preferred option. Moreover, professionals need to operate with an explicit and tested model of change before they introduce any innovation. We have discussed at length the potential for the allocation of a learning style to turn into a learning handicap. We also wish to discuss the range of options currently open to tutors and trainers in the post-compulsory sector because these professionals are not faced with the simple choice of accepting or rejecting learning styles. On the contrary, they are faced with a panoply of possible interventions, all with their supporters and attendant evidence.

As Hattie (1999) has argued, most innovations have positive effects on students' achievement, so we need estimates of the magnitude of the impact – namely, effect sizes as well as statistical significance. Post-16 learning is currently subjected to a series of pressures from policy initiatives, financial directives, institutional change strategies, qualifications and awarding bodies, the inspectorate, CPD, and student demands. Into this highly stressful environment, the case for responding to the different learning styles of students is already being pushed by managers in further education under the need for 'differentiation'. According to one FE lecturer, the new buzzword of 'differentiation' is being used 'to maintain pressure and perpetuate the feeling that things are not being done properly: that teachers are inadequate' (Everest 2003, 49).

The ***meta-analysis*** of educational interventions conducted by Hattie (1999) can help us to form a judgement on what to do next. His painstaking research indicates that the effect sizes for different types of intervention are as shown in Table 14 (extracted from Hattie 1999).

It seems sensible to concentrate limited resources and staff efforts on those interventions which have the largest effect sizes.

The case for learning styles will also have to compete with arguments in favour of, say, thinking skills, or peer tutoring, or learning identities, or formative assessment, or critical intelligence or any one of a host of options. We willl explore briefly the claims which could be made for two approaches which are competing with learning styles for research funds – namely, metacognition and formative assessment. With regard to the first competitor, we refer in Section 4 to Bruner's advice (1996) to introduce tutors, trainers and students to different conceptions of learners' minds. His advice could perhaps be accommodated by including it in the standard definition of metacognition – that is, the ability to set explicit, challenging goals; to identify strategies to reach those goals; and to monitor progress towards them.

Table 14
Effect sizes of different types of intervention

Intervention	Effect size
Reinforcement	1.13
Student's prior cognitive ability	1.00
Instructional quality	1.04
Direct instruction	0.82
Student's disposition to learn	0.61
Class environment	0.56
Peer tutoring	0.50
Parental involvement	0.46
Teacher style	0.42
Affective attributes of students	0.24
Individualisation	0.14
Behavioural objectives	0.12
Team teaching	0.06

As for the research evidence in favour of metacognition, Marzano (1998) reported on the largest meta-analysis of research on instruction ever undertaken. He found that approaches which were directed at the metacognitive level of setting goals, choosing appropriate strategies and monitoring progress are more effective in improving knowledge outcomes than those which simply aim to engage learners at the level of presenting information for understanding and use. Interventions targeted at improving metacognition produced an average gain of 26 ***percentile*** points (across 556 studies). This is about 5 points higher than the mean gain calculated for the 1772 studies in which attempts were made to improve cognition without an explicit metacognitive component.

As to the second competitor, the decision as to what innovation to introduce is made all the keener by reference to the proposals of Black and Wiliam (1998a), who conducted an extensive survey of the research literature on assessment, comparable in size to this review on learning styles. They concluded from their study of the most carefully conducted quantitative experiments that:

innovations which include strengthening the practice of formative assessment produce significant, and often substantial, learning gains. These studies range over ages (from five-year olds to university undergraduates), across several school subjects, and over several countries… The formative assessment experiments produce typical ***effect sizes*** *of between 0.4 and 0.7: such effect sizes are larger than most of those found for educational interventions*
(Black and Wiliam 1998b, 3–4; original emphasis)

Policy-makers and politicians also have important choices to make; for example, do they spend scarce resources on training all new and in-service teachers and tutors in learning styles; or would they better serve the cause of post-16 learning by using the same money to increase the new adult learning grants from the low figure of £30 per week?

Influencing the attitude of official agencies to learning styles

It is not our job, however, to make the final decision on behalf of politicians, course leaders, institutional managers or those engaged in initial teacher training: it is our task to sharpen up those decisions. Our role is to point out that the research evidence in favour of introducing either metacognition or assessment *for* learning is more robust and extensive than the evidence we have reviewed here on learning styles, regardless of whether they emerged poorly or relatively unscathed from our evaluation. Given the effects claimed for improving formative assessment in the school sector, a productive avenue for research and development may be to extend this research into post-16 education. The Assessment Reform Group, for example, has been extremely influential in promoting Black and Wiliam's ideas (1998a, 1998b) and is about to extend its work into post-16 assessment.

Other organisations, such as the QCA, awarding bodies, the post-16 inspectorates, NIACE, the Association of Colleges (AoC), the Universities Council for the Education of Teachers' (UCET) post-16 committee and the DfES Standards Unit already have their own list of priorities for research, and we hope to engage them critically with the conclusions of our report. In addition, any further research in response to our report would benefit strongly from being connected closely to other high-profile research into post-16 learning and pedagogy such as the Economic and Social Research Council's (ESRC) Teaching and Learning Research Programme (TLRP).

For convenience, we list here some specific recommendations for some of the main institutional players.

- *DfES* – different branches of the DfES are currently engaged in initiatives that draw on learning styles research; they need to reflect on our report before deciding to fund any research or practice using the inventories we review here and before issuing guidelines about 'best practice' in teaching or learning styles.
- *QCA and awarding bodies* – assessment specifications and guidance to teachers (eg about differentiation) reveal explicit and implicit assumptions about learning styles; officials therefore need to review these assumptions, particularly in relation to qualifications for post-16 teacher training.
- *FENTO, the UCET's post-16 committee and the National Leadership College* – the national standards of competence for teacher training in further education contain uncritical and unsustainable attitudes towards learning styles, while standards for management training contain no references to learning at all: FENTO officials and providers of initial teacher education for the learning and skills sector need to assess the implications of our report for these qualifications and for training teachers and managers.
- *Ofsted and ALI* – although neither inspectorate appears to have an official view on learning styles, reports on particular institutions reveal simplistic assumptions about learning styles as the basis for judgements about 'good practice'; these assumptions need to be re-assessed in the light of our report.

Continuing problems within the research field of learning styles

Theoretical incoherence and conceptual confusion

The field of learning styles consists of a wide variety of approaches that stem from different perspectives which have some underlying similarities and some conceptual overlap. There are numerous groups working in isolation from each other and, with few exceptions, from mainstream research in psychology. Research into learning styles can, in the main, be characterised as small-scale, non-cumulative, uncritical and inward-looking. It has been carried out largely by cognitive and educational psychologists, and by researchers in business schools and has not benefited from much interdisciplinary research.

As a result, as Sternberg has argued: 'the literature has failed to provide any common conceptual framework and language for researchers to communicate with each other or with psychologists at large' (2001, 250). The previous sections of this review have provided detailed evidence of a proliferation of concepts, instruments and pedagogical strategies, together with a 'bedlam of contradictory claims' (Reynolds 1997, 116). The sheer number of dichotomies in the literature conveys something of the current conceptual confusion. We have, in this review (this report and Coffield *et al.* 2004), for instance, referred to:

- convergers versus divergers
- verbalisers versus imagers
- holists versus serialists
- deep versus surface learning
- activists versus reflectors
- pragmatists versus theorists
- adaptors versus innovators
- assimilators versus explorers
- field dependent versus field independent
- globalists versus analysts
- assimilators versus accommodators
- imaginative versus analytic learners
- non-committers versus plungers
- common-sense versus dynamic learners
- concrete versus abstract learners
- random versus sequential learners
- initiators versus reasoners
- intuitionists versus analysts
- extroverts versus introverts
- sensing versus intuition
- thinking versus feeling
- judging versus perceiving
- left brainers versus right brainers
- meaning-directed versus undirected
- theorists versus humanitarians
- activists versus theorists
- pragmatists versus reflectors
- organisers versus innovators
- lefts/analytics/inductives/successive processors versus rights/globals/deductives/simultaneous processors
- executive, hierarchic, conservative versus legislative, anarchic, liberal.

The sheer number of dichotomies betokens a serious failure of accumulated theoretical coherence and an absence of well-grounded findings, tested through replication. Or to put the point differently: there is some overlap among the concepts used, but no direct or easy comparability between approaches; there is no agreed, 'core' technical vocabulary. The outcome – the constant generation of new approaches, each with its own language – is both bewildering and off-putting to practitioners and to other academics who do not specialise in this field.

In addition, the complexity of the learning styles field and the lack of an overarching synthesis of the main models, or of dialogue between the leading proponents of individual models, lead to the impression of a research area that has become fragmented, isolated and ineffective. In the last 20 years, there has been only a single use of the term 'learning styles' and three uses of the term 'cognitive styles' in the *Annual Review of Psychology*. We have also noted that these terms are not included in the indexes in four widely used textbooks on cognitive and educational psychology. Instead, psychometric specialists speak mainly to each other about the merits or otherwise of particular instruments. Even the proponents of the more credible models, namely those offered by Allinson and Hayes (see Table 1, Section 3) or Vermunt (Table 13, Section 3), tend not to engage with each other's models or those from other families.

Although the theorists tend to claim routinely that all learning styles within a particular model are equally viable, the terminology that they have chosen is neither neutral nor value-free. It is clearly preferable, for instance, to use a *deep* rather than *surface* learning approach, to be *field independent* rather than *field dependent*, and to exhibit the *hierarchic* rather than the *anarchic* thinking style. Yet, as our review of Entwistle's model (Table 4, Section 3) showed, sometimes a strategic approach is effective and students need to be able to judge when different approaches to learning are appropriate. The value judgements evident in various models need to be made more explicit if students are independently to evaluate the different approaches to learning styles.

Learning styles in practice: labelling, vested interests and overblown claims

The theorists warn of the dangers of labelling, whereby teachers come to view their students as being a certain type of learner, but despite this warning, many practitioners who use their instruments think in stereotypes and treat, for instance, vocational students as if they were all non-reflective activists. The literature is full of examples of practitioners and some theorists themselves referring to 'globals and analytics' (Brunner and Majewski 1990, 22), or 'Quadrant Four learners' (Kelley 1990, 38), or 'integrated hemisphere thinkers' (Toth and Farmer 2000, 6). In a similar vein, Rita Dunn writes as follows: 'It is fascinating that analytic and global youngsters appear to have different environmental and physiological needs' (1990c, 226). Similarly, students begin to label themselves; for example, at a conference attended by one of the reviewers an able student reflected – perhaps somewhat ironically – on using the Dunn, Dunn and Price Productivity Environmental Preference Survey (PEPS): 'I learned that I was a low auditory, kinaesthetic learner. So there's no point in me reading a book or listening to anyone for more than a few minutes'. The temptation to classify, label and stereotype is clearly difficult to resist. Entwistle has repeatedly warned against describing students as 'deep' or 'surface' learners, but these warnings tend to be ignored when instruments move into mainstream use.

Another tendency among some of the researchers whose work was reviewed earlier in this report has been 'to rush prematurely into print and marketing with very early and preliminary indications of factor *loadings* based on one dataset' (Curry 1990, 51). The field is bedevilled by vested interests because some of the leading developers of learning style instruments have themselves conducted the research into the psychometric properties of their own tests, which they are simultaneously offering for sale in the marketplace. We shall return later in this section to the need for critical, independent research which is insulated from the market.

Moreover, the status of research in this field is not helped by the overblown claims of some of the developers and their enthusiastic devotees. For example, Carbo, the director of the National Reading Styles Institute in the US, claimed that when staff were trained for 4 or 5 days in 'matching' techniques, 'very often the results have been phenomenal, not just significant. We've had some gains of 10 times as high as students were achieving before' (quoted by O'Neil 1990, 7). Rigorously conducted research, as we saw earlier, has experienced difficulty in establishing that matching produced significant, never mind phenomenal, gains. The commercial industry that has grown around particular models makes independent researchers think twice before publicly criticising either the shortcomings of the models or the hyperbolic claims made for them.

These central features of the research field – the isolated research groups, the lack of theoretical coherence and of a common conceptual framework, the proliferating models and dichotomies, the dangers of labelling, the influence of vested interests and the disproportionate claims of supporters – have created conflict, complexity and confusion. They have also produced wariness and a growing disquiet among those academics and researchers who are interested in learning, but who have no direct personal or institutional interest in learning styles. After more than 30 years of research, no consensus has been reached about the most effective instrument for measuring learning styles and no agreement about the most appropriate pedagogical interventions.

Nor are there any signs of the leading theorists coming together to address the central problems of their field. If left to itself, research into learning styles looks as if it will continue to produce more disorganised proliferation. A psychological version of Gresham's Law is already in operation in that the bad publicity caused by unreliable and invalid instruments is turning those interested in improving the quality of learning away from the achievements of the more careful scholars in the field. As we argued in Section 4, the vacuum created by the absence of an agreed theory (or theories) of post-16 pedagogy, and by the lack of widespread understanding about learning has enabled those versions of 'best practice' produced by the DfES to gain prominence.

The variable quality of learning style models

This report and Coffield *et al.* (2004) examined in considerable detail 13 models of learning style and one of the most obvious conclusions is the marked variability in quality among them; they are not all alike nor of equal worth, and it matters fundamentally which instrument is chosen. The evaluation, which is reported at the end of Section 3, showed that some of the best known and widely used instruments have such serious weaknesses (eg low reliability, poor validity and negligible impact on pedagogy) that we recommend that their use in research and in practice should be discontinued. On the other hand, other approaches emerged from our rigorous evaluation with fewer defects and, with certain reservations detailed below, we suggest that they deserve to be researched further. A brief summarising comment is added about each of the models that we appraised as promising:

Allinson and Hayes: of all the instruments we have evaluated, the Cognitive Style Index (CSI) of Allinson and Hayes has the best psychometric credentials, despite the debate about whether it should be scored to yield one or two measures of *intuition and analysis*. It was designed to be used in organisational and business contexts, and is less relevant for use with students than by teachers and managers. It was designed as a simple instrument and its items are focused very transparently on decision making and other procedures at work. Although there is already some evidence of predictive validity, the authors acknowledge that relatively little is known about how the interplay of cognitive styles in different situations relates to work outcomes such as performance, absenteeism, professional development and attitudes. It is a suitable research instrument for studying educational management as well as for more specific applications – for example, seeking to identify the characteristics of successful entrepreneurs.

Apter: reversal theory is a theory of personality, not of learning style. It was included because the concepts of motivation and reversal (eg change from work to play) are important for understanding learning styles. Reversal theory is relevant to groups and organisations as well as to individuals, who are not pigeon-holed as having fixed characteristics. Apter's Motivational Style Profile (MSP) is a useful addition to learning style instruments.

Entwistle: his Approaches and Study Skills Inventory for Students (ASSIST) is useful as a sound basis for discussing effective and ineffective strategies for learning and for diagnosing students' existing approaches, orientations and strategies. It is an important aid for course, curriculum and assessment design, including study skills support. It is widely used in universities for staff development and discussion about learning and course design. It could perhaps be used for higher education taught in FE colleges, but would need to be redesigned and revalidated for use in other post-16 contexts such as adult education, work-based training and 14–19 provision. It is crucial, however, that the model is not divorced from the inventory, that its complexity and limitations are understood by users, and that students are not labelled as 'deep' or 'surface' learners.

Herrmann: his 'whole brain' model is suitable for use with learners as well as with teachers and managers, since it is intended to throw light on group dynamics as well as to encourage awareness and understanding of self and others. Herrmann and others have devised well-tried procedures for facilitating personal and organisational change. In completing Hermann's Brain Dominance Instrument (HBDI), respondents draw on their experience of life outside working contexts as well as within them. Herrmann's model may prove especially valuable in education and training, since its *raison d'être* is to foster creative thinking and problem solving. It is unlikely that productive change will occur nationally in the area of lifelong learning until it is widely recognised that only a certain percentage of people function best when given a precise set of rules to follow. Although the Herrmann 'whole brain' approach to teaching and learning needs further research, development and independent evaluation within education, it is grounded in values which are inclusive, open, optimistic and systematic. More than any other model we have reviewed, it encourages flexibility, adaptation and change, rather than an avoidance of less preferred activities.

Jackson: the Learning Styles Profiler (LSP) is a relatively new, but sophisticated, instrument which has yet to be tested by independent researchers. Jackson acknowledges that learning styles are influenced by biology, experience and conscious control. It deserves to be widely studied.

Vermunt: his Inventory of Learning Styles (ILS) can be safely used in higher education, both to assess approaches to learning reliably and validly, and to discuss with students changes in learning and teaching. It is already being used widely in northern Europe to research the learning of undergraduates and so may be relevant for those settings in post-16 learning which are closest to higher education. It will need, however, to be completely revalidated for the wide range of learning contexts in post-16 learning which have little in common with higher education.

Psychometric weaknesses

This report and Coffield *et al.* (2004) selected for detailed study 13 of the most influential models of learning styles from a total of 71 which we identified in the literature. [Mitchell (1994) claimed that there were over 100 models, but we have found 71 worthy of consideration.] Each model was examined for evidence, provided by independent researchers, that the instrument could demonstrate *both* internal consistency and test–retest reliability *and* construct and predictive validity. These are the minimum standards for any instrument which is to be used to redesign pedagogy. Only three of the 13 models – those of Allinson & Hayes, Apter and Vermunt – could be said to have come close to meeting these criteria. A further three – those of Entwistle, Herrmann and Myers-Briggs met two of the four criteria. The Jackson model is in a different category, being so new that no independent evaluations have been carried out so far. The remaining six models, despite in some cases having been revised and refined over 30 years, failed to meet the criteria and so, in our opinion, should not be used as the theoretical justification for changing practice.

Table 15
13 learning styles models matched against minimal criteria

✓
criterion met

×
criterion not met

–
no evidence either way or issue still to be settled

Note
The evaluation is in all cases 'external', meaning an evaluation which explored the theory or instruments associated with a model and which was not managed or supervised by the originator(s) of that model.

		Internal consistency	Test–retest reliability	Construct validity	Predictive validity
1	**Jackson**	–	–	–	–
2	**Riding**	×	×	×	×
3	**Sternberg**	×	×	×	×
4	**Dunn and Dunn**	×	×	×	✓
5	**Gregorc**	×	×	×	✓
6	**Honey and Mumford**	×	✓	×	×
7	**Kolb**	–	✓	×	×
8	**Entwistle**	✓	–	✓	×
9	**Herrmann**	–	✓	✓	–
10	**Myers-Briggs**	✓	✓	×	×
11	**Apter**	✓	✓	–	✓
12	**Vermunt**	✓	✓	✓	×
13	**Allinson and Hayes**	✓	✓	✓	✓

Table 15 presents our psychometric findings diagrammatically. It can be seen that only Allinson and Hayes met all four of the minimal criteria and that Riding and Sternberg failed to meet any of them. Jackson's model has still to be evaluated. In more detail, the 13 instruments can be grouped as follows:

- those meeting none of the four criteria: Jackson; Riding; Sternberg
- those meeting one criterion: Dunn and Dunn; Gregorc; Honey and Mumford; Kolb
- those meeting two criteria: Entwistle; Herrmann; Myers-Briggs
- those meeting three criteria: Apter, Vermunt
- those meeting all four criteria: Allinson and Hayes.

There are other limitations to psychometric measures of approaches to learning, highlighted in our review of Entwistle's model (Table 4, Section 3). For example, apparently robust classifications of students' orientations to learning derived from a questionnaire are shown to be unreliable when the same students are interviewed. Moreover, self-report inventories 'are not sampling learning behaviour but learners' impressions' (Mitchell 1994,18) of how they learn, impressions which may be inaccurate, self-deluding or influenced by what the respondent thinks the psychologist wants to hear. As Price and Richardson (2003, 287) argue: 'the validity of these learning style inventories is based on the assumption that learners can accurately and consistently reflect (a) how they process external stimuli and (b) what their internal cognitive processes are'.

The unwarranted faith placed in simple inventories

A recurrent criticism we made of the 13 models studied in detail in Sections 3–7 of Coffield *et al.* (2004) was that too much is being expected of relatively simple, self-report tests. Kolb's LSI, it may be recalled, now consists of no more than 12 sets of four words to choose from. Even if all the difficulties associated with self-report (ie the inability to categorise one's own behaviour accurately or objectively, giving socially desirable responses, etc; see Riding and Rayner 1998) are put to one side, other problems remain. For example, some of the questionnaires, such as Honey and Mumford's, force respondents to agree or disagree with 80 items such as 'People often find me insensitive to their feelings'. Richardson (2000, 185) has pointed to a number of problems with this approach:

the respondents are highly constrained by the predetermined format of any particular questionnaire and this means that they are unable to calibrate their understanding of the individual items against the meanings that were intended by the person who originally devised the questionnaire or by the person who actually administers it to them

We therefore advise against pedagogical intervention based *solely* on any of the learning style instruments. One of the strengths of the models developed by Entwistle and Vermunt (see Tables 4 and 13, Section 3) is that concern for ecological validity has led them to adopt a broader methodology, where in-depth qualitative studies are used in conjunction with an inventory to capture a more rounded picture of students' approaches to learning.

As Curry (1987) points out, definitions of learning style and underlying concepts and theories are so disparate between types and cultures (for example, US and European) that each model and instrument has to be evaluated in its own terms. One problem is that 'differences in research approaches continue and make difficult the resolution of acceptable definitions of validity' (1987, 2). In addition, she argues that a great deal of research and practice has proceeded 'in the face of significant difficulties in the bewildering confusion of definitions surrounding cognitive style and learning style conceptualisations…' (1987, 3). Her evaluation, in 1987, was that researchers in the field had not yet established unequivocally the reality, utility, reliability and validity of these concepts. Our review of 2003 shows that these problems still bedevil the field.

Curry's evaluation (1987, 16) also offers another important caveat for policy-makers, researchers and practitioners that is still relevant 16 years later:

The poor general quality of available instruments (makes it) unwise to use any one instrument as a true indicator of learning styles … using only one measure assumes [that] *that measure is more correct than the others. At this time (1987) the evidence cannot support that assumption.*

There is also a marked disparity between the sophisticated, statistical treatment of the scores that emanate from these inventories (and the treatment is becoming ever more sophisticated), and the simplicity – some would say the banality – of many of the questionnaire items. However, it can be argued that the items need to be obvious rather than recondite if they are to be valid.

There is also an inbuilt pressure on all test developers to resist suggestions for change because, if even just a few words are altered in a questionnaire, the situation facing the respondent has been changed and so all the data collected about the test's reliability and validity is rendered redundant.

No clear implications for pedagogy

There are two separate problems here. First, learning style researchers do not speak with one voice; there is widespread disagreement about the advice that should be offered to teachers, tutors or managers. For instance, should the style of teaching be consonant with the style of learning or not? At present, there is no definitive answer to that question, because – and this brings us to the second problem – there is a dearth of rigorously controlled experiments and of longitudinal studies to test the claims of the main advocates. A move towards more controlled experiments, however, would entail a loss of ecological validity and of the opportunity to study complex learning in authentic, everyday educational settings. Curry (1990, 52) summarised the situation neatly:

Some learning style theorists have conducted repeated small studies that tend to validate the hypotheses derived from their own conceptualizations. However, in general, these studies have not been designed to disconfirm hypotheses, are open to expectation and participation effects, and do not involve wide enough samples to constitute valid tests in educational settings. Even with these built-in biases, no single learner preference pattern unambiguously indicates a specific instructional design.

An additional problem with such small-scale studies is that they are often carried out by the higher-degree students of the test developers, with all the attendant dangers of the 'Hawthorne Effect' – namely, that the enthusiasm of the researchers themselves may be unwittingly influencing the outcomes. The main questions still to be resolved – for example, whether to match or not – will only be settled by large-scale, randomly controlled studies, using experimental and control groups.

It may be argued that it is important to provide for all types of learning style in a balanced way during a course of study in order to improve the learning outcomes of all students. Yet the problem remains: which model of learning styles to choose? Many courses in further and adult education are short or part-time, making the choice more difficult still.

This particular example reinforces our argument about the need for any pedagogical innovation to take account of the very different contexts of post-16 learning. These contextual factors include resources for staff development and the need for high levels of professional competence if teachers are to respond to individual learning styles. Other pressures arise from narrow ideas about 'best practice', the nature of the teaching profession (so many part-timers) and the limited opportunities for discussing learning in post-16 initial teacher education programmes.

We also wish to stress that pedagogy should not be separated from a deeper understanding of motivation and from the differing values and beliefs about learning held by staff within the various traditions in further and adult education and work-based learning. For example, if teachers and students regard education as being primarily about the accumulation of human capital and the gaining of qualifications, they are more likely to employ surface learning as a way of getting through the assessment requirements as painlessly as possible. Moreover, the way that staff in schools, further education and higher education teach and assess the curriculum may be encouraging 'surface' or 'strategic' rather than 'deep' learning.

The tentative conclusion from some researchers (eg Boyle *et al.* 2003; Desmedt *et al.* 2003) is that while the dominant pedagogy in higher education with its emphasis on analytic processes is encouraging 'surface' or 'strategic' learning, and while tutors commend 'deep learning' but at the same time spoon-feed their students, the world of work claims that it is crying out for creative, 'rule-bending' and original graduates who can think for themselves. In particular, Desmedt *et al.* (2003) in a study of both medical and education students concluded that, because of the curriculum, students are not interested in learning, but in assessment.

Decontextualised and depoliticised views of learning and learners

The importance of context serves to introduce a further problem, which is best illustrated with an example. One of the items from the Sternberg–Wagner Self-Assessment Inventory on the Conservative Style reads as follows: 'When faced with a problem, I like to solve it in a traditional way' (Sternberg 1999, 73). Without a detailed description of the *kind* of problem the psychologist has in mind, the respondent is left to supply a context of his or her choosing, because methods of solving a problem depend crucially on the character of that problem. The Palestinian–Israeli conflict, the fall in the value of stocks and shares, teenage pregnancies and the square root of -1 are all problems, some of which may be solved in a traditional way, some of which may need new types of solution, while others still may not be amenable to solution at all. Crucially, some problems can only be resolved collectively. Nothing is gained by suggesting that all problems are similar or that the appropriate reaction of a respondent would be to treat them all in a similar fashion.

Reynolds, in a fierce attack on the research tradition into learning styles, has criticised it not only for producing an individualised, decontextualised concept of learning, but also for a depoliticised treatment of the differences between learners which stem from social class, race and gender. In his own words, 'the very concept of learning style obscures the social bases of difference expressed in the way people approach learning' and 'labelling is not a disinterested process, even though social differences are made to seem reducible to psychometric technicalities' (1997, 122, 127). He goes on to quote other critics who claim that in the US, Black culture has been transformed into the concrete, as opposed to the abstract, learning style. His most troubling charge is that the learning style approach contributes 'the basic vocabulary of discrimination to the workplace through its incorporation into educational practice' (1997, 125).

There is indeed a worrying lack of research in the UK into learning styles and social class, or learning styles and ethnicity, although more of the latter have been carried out in the US. It is worth pointing out that when Sadler-Smith (2001) published his reply to Reynold's wide-ranging critique, he did not deal with the most serious charge of all, namely that of discrimination, apart from advising practitioners and researchers to be alert to the possible dangers.

The main charge here is that the socio-economic and the cultural context of students' lives and of the institutions where they seek to learn tend to be omitted from the learning styles literature. Learners are not all alike, nor are they all suspended in cyberspace via distance learning, nor do they live out their lives in psychological laboratories. Instead, they live in particular socio-economic settings where age, gender, race and class all interact to influence their attitudes to learning. Moreover, their social lives with their partners and friends, their family lives with their parents and siblings, and their economic lives with their employers and fellow workers influence their learning in significant ways. All these factors tend to be played down or simply ignored in most of the learning styles literature.

Lack of communication between different research perspectives on pedagogy

What is needed in the UK now is a theory (or set of theories) of pedagogy for post-16 learning, but this does not exist. What we have instead is a number of different research schools, each with its own language, theories, methods, literature, journals, conferences and advice to practitioners; and these traditions do not so much argue with, as ignore, each other. We have, for example, on the one hand those researchers who empirically test the theories of Basil Bernstein and who seem almost totally unaware of – or at least appear unwilling to engage with – the large body of researchers who study learning styles and pedagogy and whose models we review in this report. For example, the recent collection of articles devoted to exploring Bernstein's contribution to developing a sociology of pedagogy (Morais *et al.* 2001) contains only two references by one out of 15 contributors to the work of 'Entwhistle' *(sic)*. The learning style researchers, for their part, continue to write and argue among themselves, either as if Bernstein's theorising on pedagogy had never been published or as if it had nothing important to say about their central research interests. For instance, Entwistle's publications contain neither a detailed discussion of Bernstein's thinking nor even a reference to it.

Similarly, there are other groups of researchers who explore the ideas of Bourdieu or Engeström or Knowles and are content to remain within their preferred paradigm, choosing to ignore significant and relevant research in cognate areas. There are, however, honourable exceptions which prove the rule; Daniels (2001), for example, has contrasted the two theoretical traditions of Engeström (activity theory) and Bernstein (pedagogy); and his book *Vygotsky and pedagogy* shows how Bernstein's contribution may lead to a generative model of pedagogy 'which connects a macro level of institutional analysis with the micro level of interpersonal analysis' (2001, 175). The rhetoric of the universities' funding councils attempts to counteract such compartmentalisation and fragmentation by extolling the virtues of interdisciplinary research, but their current reward structures [eg the Research Assessment Exercise (RAE)] continue to remunerate those who develop narrow specialisations.

Within the subject discipline of education, one of the most unhelpful divisions is that between sociologists and psychologists who too often hold each other's research in mutual suspicion, if not contempt. For example, at psychological conferences, many psychologists, when talking to each other, use the adjective 'sociological' as a pejorative term, which they place, as it were, within inverted commas to indicate their distaste, if not fear; sociology for them is neither history nor politics nor a discipline in its own right. Similarly, at their conferences, sociologists too readily dismiss the work of psychologists by hinting that the latter choose their discipline in the hope of finding some insight into, and some alleviation of, their personal problems.

The practical consequence of this divide is two separate literatures on pedagogy which rarely interact with each other. Typically, sociologists and psychologists pass each other by in silence, for all the world like two sets of engineers drilling two parallel tunnels towards the same objective in total ignorance of each other.

One of the values of the concept of lifelong learning is that it should make us re-examine the major stratifications within the education system because the very notion implies continuity and progression. Zukas and Malcolm, however, point out that instead of conceptual bridges, we run into pedagogical walls 'between those sectors that might be regarded as contributing to the virtual concept of lifelong learning. There is little conceptual connection between adult and further education, higher education, training and professional development' (2002, 203).

What national policy and local practice need, however, is for these unconnected literatures to be brought together, and for the main protagonists to be actively encouraged to use each other's findings, *not* to poke fun at their opponents, but to test and improve their own ideas. Such a rapprochement is one of the biggest challenges facing the ESRC's programme of research into teaching and learning in the post-compulsory phase (see www.tlrp.org) and could become one of its most significant achievements. It would be a fitting tribute to Bernstein's memory if there were to be wider recognition of his argument that what is required is less allegiance to an approach but more dedication to a problem.

The comparative neglect of knowledge

At the eighth annual conference of the European Learning Styles Information Network (ELSIN) at the University of Hull in July 2003, an advocate of the Dunn and Dunn model announced: 'In the past, we taught students knowledge, skills and attitudes. We must now reverse the order. We should now be teaching attitudes, skills and knowledge.' This has become a fashionable platitude which, if put into operation, would result in the modish but vacuous notion of a content-free curriculum, all learning styles and little or no subject knowledge. This downgrading of knowledge is, irony of ironies, to be implemented in the interests of creating a knowledge-based economy. It is also worth pointing out that the greater emphasis on process, which Klein *et al.* (2003) employed when introducing the Dunn and Dunn model to FE colleges, did *not* lead to higher attainment by the students in the experimental group.

The more sophisticated learning style models appreciate that different disciplines require different teaching, learning and assessment methods. Entwistle, McCune and Walker (2001, 108), for example, are clear on this point: 'The processes involved in a deep approach have to be refined within each discipline or professional area to ensure they include the learning processes necessary for conceptual understanding in that area of study'.

Alexander (2000, 561) knew he was adopting an unfashionable standpoint when he argued that it was:

a fact that different ways of knowing and understanding demand different ways of learning and teaching. Mathematical, linguistic, literary, historical, scientific, artistic, technological, economic, religious and civic understanding are not all the same. Some demand much more than others by way of a grounding in skill and propositional knowledge, and all advance the faster on the basis of engagement with existing knowledge, understanding and insight.

Gaps in knowledge and possible future research projects

Our review shows that, above all, the research field of learning styles needs independent, critical, longitudinal and large-scale studies with experimental and control groups to test the claims for pedagogy made by the test developers. The investigators need to be independent – that is, without any commitment to a particular approach – so that they can test, for instance, the magnitude of the impact made by the innovation, how long the purported gains last, and employ a research design which controls for the 'Hawthorne Effect'. Also, given the potential of Apter's Motivational Styles Profiler (MSP), Herrmann's Brain Dominance Instrument (HBDI) and Jackson's Learning Styles Profiler (LSP), they should now be tested by other researchers.

It would also be very useful to find out what learning style instruments are currently being used in FE colleges, in ACE and in WBL and for what purposes. A number of research questions could be addressed, as follows.

- Do students/employees receive an overview of the whole field with an assessment of its strengths and weaknesses?
- Are they introduced to one model and if so, on what grounds?
- How knowledgeable are the tutors about the research field on learning styles?
- What impacts are learning styles having on methods of teaching and learning?
- How well do learning style instruments predict attainment in post-16 learning?
- Are students being labelled by tutors, or are they labelling themselves, or do they develop a broader repertoire of learning styles?
- Do students and staff know how to monitor and improve their own learning via metacognition?
- How far do different types of motivation affect students' and teachers' responses to knowledge about their learning styles?
- How adequate is the training that teachers and tutors receive on learning styles?
- Given a free choice, would tutors and managers choose to introduce learning styles or some other intervention?
- What is the impact of individualised instruction on attainment within the different contexts of post-16 learning?

Only empirical research can answer these questions.

We still do not know, as Grasha pointed out (1984, 51) 'the costs and benefits of designing classroom methods and procedures based on learning styles versus continuing to do what is already done'. That type of knowledge is essential before any large-scale reforms of pedagogy on the basis of learning styles are contemplated. Grasha's question, however, prompts another, more fundamental one: should research into learning styles be discontinued, as Reynolds has argued? In his own words: 'Even using learning style instruments as a convenient way of introducing the subject [of learning] generally is hazardous because of the superficial attractions of labelling and categorizing in a world suffused with uncertainties' (1997, 128). Our view is that such a policy is too undiscriminating and our review of the leading models (see Section 3) counsels the need to be highly selective.

The suggestions made here for further research would necessitate the investment of considerable financial and human resources over a long period of time in order to make learning styles relevant to a diverse post-16 sector. But would such investment pay real dividends and is it the highest priority for research funding in the sector?

Final comments

This report has sought to sift the wheat from the chaff among the leading models and inventories of learning styles and among their implications for pedagogy: we have based our conclusions on the evidence, on reasoned argument and on healthy scepticism. For 16 months, we immersed ourselves in the world of learning styles and learned to respect the enthusiasm and the dedication of those theorists, test developers and practitioners who are working to improve the quality of teaching and learning. We ourselves have been reminded yet again how complex and varied that simple-sounding task is and we have learned that we are still some considerable way from an overarching and agreed theory of pedagogy. In the meantime, we agree with Curry's summation (1990, 54) of the state of play of research into learning styles: 'researchers and users alike will continue groping like the five blind men in the fable about the elephant, each with a part of the whole but none with full understanding'.

Our penultimate question is: what are the prospects for the future of learning styles? From within the discipline, commentators like Cassidy (2003) are calling for rationalisation, consolidation and integration of the more psychometrically robust instruments and models. Is such integration a likely outcome, however? We wish it were, but some internal characteristics of the field militate against rationalisation.

First, learning styles models and instruments are being simultaneously developed in the relatively autonomous university departments of business studies, education, law, medicine and psychology. No one person or organisation has the responsibility to overview these sprawling fields of endeavour and to recommend changes; in the UK, the academic panels for the RAE are subject-based and the area of learning styles straddles three, if not more, of the existing units of assessment.

Second, fortunes are being made as instruments, manuals, videotapes, in-service packages, overhead transparencies, publications and workshops are all commercially advertised and promoted vigorously by *some* of the leading figures in the field. In short, the financial incentives are more likely to encourage further proliferation than sensible integration. It also needs to be said that there are other, distinguished contributors to research on learning styles who work in order to enhance the learning capabilities of individuals and firms and not in order to make money.

Third, now that most of the instruments can be administered, completed and scored online, it has become a relatively simple matter to give one's favourite learning styles inventory (no matter how invalid or unreliable) to a few hundred university students who complete the forms as part of their course; in this way, some trivial hypothesis can be quickly confirmed or refuted. The danger here is of mindless and atheoretical empiricism. We conclude that some order will, sooner or later, have to be imposed on the learning styles field from outside.

Finally, we want to ask: why should politicians, policy-makers, senior managers and practitioners in post-16 learning concern themselves with learning styles, when the really big issues concern the large percentages of students within the sector who either drop out or end up without any qualifications? Should not the focus of our collective attention be on asking and answering the following questions?

- Are the institutions in further, adult and community education in reality centres of learning for *all* their staff and students?
- Do some institutions constitute in themselves barriers to learning for certain groups of staff and students?

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Appendix 1

List of learning styles instruments and theories
(models chosen for study in bold type)

Author(s)	Measure	Key terms/descriptors	Date introduced
Allinson and Hayes	**Cognitive Style Index (CSI)**	***intuitive/analytic***	**1996**
Apter	**Motivational Style Profile (MSP)**	***telic/paratelic – negativism/conformity – autic mastery/autic sympathy – alloic mastery/alloic sympathy – arousal avoidance/arousal seeking – optimism/pessimism – arousability – effortfulness***	**1998**
Bartlett		*sensory modality preferences*	1932
Betts	Betts Inventory	*imagery*	1909
Biggs	Study Process Questionnaire	*surface/deep achieving*	1987
Broverman		*automatisation – restructuring*	1960
Cacioppo and Petty	Need for Cognition Scale	*related to field dependence/independence – articulative/global*	1982
Canfield	Canfield Learning Style Inventory (CLSI)	*conditions – content – modes – expectancy*	1980
Christensen	Lifescripts	*(social context but relevant to cognition) analyser – controller – supporter – promoter*	1980
Conti and Kolody	Self-Knowledge Inventory of Lifelong Learning Skills (SKILLS)	*metacognition – metamotivation – memory – critical thinking – resource management*	1990
Cooper	Learning Styles ID	*visual/verbal – holist/analyst, environmental preference*	1997
Curry	'Onion' model	*instructional preference – information processing style – cognitive personal style*	1983
Das		*simultaneous/successive processing and planning*	1988
Dunn and Dunn	**Learning Style Questionnaire (LSQ)** **Learning Styles Inventory** **Productivity Environmental Preference Survey (PEPS)** **Building Excellence Survey (BES)**	***environmental – emotional – sociological – physiological processing***	**1979** **1975** **1979** **2003**
Entwistle	■ **Approaches to Study Inventory (ASI)** ■ **Revised Approaches to Study Inventory (RASI)** ■ **Approaches and Study Skills Inventory for Students (ASSIST)**	■ **meaning orientation – reproducing orientation – achieving orientation – non-academic orientation – self-confidence** ■ **deep approach – surface approach – strategic approach – lack of direction – academic self-confidence – metacognitive awareness**	**1979** **1995** **2000**
Epstein and Meier	Constructive Thinking Inventory (CTI)	*emotional coping – behavioural coping – personal superstitious thinking – categorical thinking – esoteric thinking – naïve optimism – global constructive thinking*	1989
Felder and Silverman	Index of Learning Styles (ILS)	*active/reflective – sensing/intuitive – visual/verbal – sequential/global*	1996
Friedman and Stritter	Instructional Preference Questionnaire		1976
Galbraith and James		*perceptual ability*	1984
Gardner *et al.*		*tolerant/intolerant*	1959
Gordon	Scale of Imagery Control	*imagery*	1949

Author(s)	Measure	Key terms/descriptors	Date introduced
Grasha-Riechmann	Student Learning Style Scales (SLSS)	*competitive/collaborative – independent/dependent – participant/avoidant*	1974
Gregorc	**Gregorc Mind Styles Delineator (MSD)**	***concrete sequential/abstract random – abstract sequential/concrete random***	**1977**
Groner	Cognitive Style Scale	*heuristic/algorithmic*	1990
Guilford		*convergent/divergent thinking*	1950
Harrison-Branson	Revised Inquiry Mode Questionnaire	*synthesist – idealist – pragmatist – analyst – realist*	1998
Herrmann	**Brain Dominance Instrument (HBDI)**	***theorist/humanitarian – organiser/innovator***	**1995**
Hermanussen, Wierstra, de Jong & Thijssen	Questionnaire Practice-oriented Learning (QPL)	*immersion – reflection – conceptualisation – experimentation – regulation*	2000
Hill	Cognitive Style Profile	*symbol processing – modalities of inference – cultural determinants*	1976
Holzman & Klein	Schematising Test	*leveller/sharpener*	1954
Honey and Mumford	**Learning Styles Questionnaire (LSQ)**	***activist/reflector – theorist/pragmatist***	**1982**
Hudson	(following Guilford)	*diverging/converging*	1966
Hunt	Paragraph Completion Method	*need for structure: conforming – dependent*	1978
Jackson	**Learning Styles Profiler (LSP)**	***initiator – analyst – reasoner – implementer***	**2002**
Kagan	Matching Familiar Figures Test	*impulsivity/reflexivity – focus/scan*	1965 1967
Kaufmann	The A-E Inventory	*assimilator/explorer*	1989
Keefe and Monke (NASSP)	NASSP Learning Style Profile (explicit attempt at meta-taxonomy)	*physiological – environmental – cognitive – affective domains plus information processing*	1986
Kirby *et al.*	Multidimensional verbal-visual LSQ	*verbal/visual*	1988
Kirton	Kirton Adaption-Innovation inventory (KAI)	*adaptor/innovator*	1989
Kogan	Sorting styles into types	*3 types of style:* ■ *maximal performance (ability) measures* ■ *value directionality (advantageous) styles* ■ *value-differentiated measures*	1973
Kolb	**Learning Style Inventory (LSI)** **Revised Learning Style Inventory (R-LSI)** **LSI Version 3**	***accommodating – diverging – converging – assimilating styles***	**1976** **1985** **1999**
Letteri	Cognitive Style Delineators	*analytic/global*	1980
Marks	Marks Vividness of Visual Imagery Questionnaire	*imagery*	1973
Marton & Säljö		*deep/surface processing*	1976

Author(s)	Measure	Key terms/descriptors	Date introduced
McCarthy	4MAT	*innovative – analytic – common-sense – dynamic*	1987
McKenney and Keen	Model of cognitive style	*perceptive/receptive – systematic/intuitive*	1974
Meredith		*focus/scan*	1981
Messick		*analytic/non-analytic conceptualising*	1976
Miller	Personality typology: cognitive, affective, conative	*analyst/holist – emotional stability/instability – objective-subjective*	1991
Myers-Briggs	**Myers-Briggs Type Indicator (MBTI)**	***perceiving/judging – sensing/intuition – thinking/feeling – extraversion/introversion***	**1962**
Paivio	Individual Difference Questionnaire (IDQ)	*imagery (dual coding)*	1971
Pask		*serialist/holist*	1976
Pettigrew	Scale of cognitive style	*category width (broad/narrow)*	1958
Pintrich, Smith, Garcia & McCeachie	Motivated Strategies for Learning Questionnaire	*goal orientation (intrinsic/extrinsic) – expectancy – anxiety – cognitive strategies (rehearsal, selection, organisation, elaboration, metacognition, surface processing, critical thinking, original thinking) – resource management*	1991
Reinert	Edmonds Learning Style Identification Exercise (ELSIE)	*types of perception: visual – verbal – aural – emotional*	1976
Renzulli-Smith	Learning Style Inventory	*teaching styles and learning contexts*	1978
Rezler-Rezmovic	Learning Preference Inventory	*abstract/concrete – individual/interpersonal – teacher structure/student structure*	1981
Richardson	Verbaliser Visualiser Questionnaire (after Paivio)	*verbaliser/visualiser*	1977
Riding	**Cognitive Styles Analysis (CSA)**	**holist/analytic – verbaliser/imager**	**1991**
Schmeck *et al.*	Inventory of Learning Processes	*deep processing – shallow processing – elaborative processing – serial processing – holistic processing*	1977
Sheehan	Shortened Betts Inventory	*imagery*	1967
Sternberg	**Thinking Styles**	***functions – forms – levels – scopes – meanings***	**1998**
Tamir-Cohen	Cognitive Preference Inventory	modes – recall principles – questioning applications	1980
Torrance	Style of Learning and Thinking	creative thinking	1990
Vermunt	**Inventory of Learning Styles (ILS)**	**meaning-directed – application-directed – reproduction-directed – undirected**	**1996**
Walters	Psychological Inventory of Criminal Thinking Styles	confusion – defensiveness – mollification – cut-off – entitlement – power orientation – sentimentality – superoptimism – cognitive indolence – discontinuity	1995

Author(s	Measure	Key terms/descriptors	Date introduced
Weinstein, Zimmerman and Palmer	Learning and Study Strategies Inventory	*cognitive processing – motivation – metacognitive regulation*	1988
Whetton and Cameron	Cognitive Style Questionnaire (CSQ) [based on McKenney and Keen]	*gathering: perceptive/receptive evaluating: systematic/intuitive responding: active/reflective*	1984
Wierstra			
Witkin	Group Embedded Figures Test (GEFT)	*field dependence/independence*	1962
Zimmerman and Martinez-Pons	Self-Regulated Learning Interview Schedule (SRLIS)	*14 strategies*	1986

Appendix 2

List of search terms used in the literature review

Key terms

Learning style/s
Cognitive style/s
Conative style/s
Thinking style/s
Learning preference/s, strategy/ies, orientation/s

Key terms were linked with the following for refined searches:

reliability
validity
attainment
impact
scores
instructional design
match
attributions
personality
gender
social class/socio-economic status
culture
decision making

adult applications
lifelong learning
learning cycle
field independence
brain/hemispheric dominance

In addition, searches were made for references to key instruments, as defined by this report.

Appendix 3

Glossary of terms

affective
characterised by emotion

analytic
focusing on the parts of a whole or on underlying basic principles

catalytic validity
the extent to which those involved in research become motivated to understand and transform the situations in which they operate

cognitive
concerned with the psychological processes of perception, memory, thinking and learning

conative/conation
refers to effort, endeavour and the will to achieve

concurrent validity
support for the meaning of a construct or the value of a test, based on correlational evidence from another set of measurements taken at the same time

construct
abstract or general idea inferred from specific instances

construct validity
how far test scores can be interpreted as measuring only what they are intended to measure

correlation
a measure indicating how far two variables are totally unconnected (zero correlation), or are negatively (eg -0.5) or positively related, as determined by underlying or outside influences

deductive
reasoning from a general statement or definition to a particular instance

diagnosis
identifying the nature or causation of a problem

disposition
habit of mind, mood or attitude

ecological validity
the quality of being well grounded in the reality of a particular context

effect size
a measure of difference or gain in average scores, whereby effect sizes of less than 0.2 are usually considered trivial; between 0.2 and 0.5 small; between 0.5 and 0.8 moderate; and when 0.8 or more, large

face validity
support for an assessment tool based on a common-sense judgement that the test items appear to measure what they are claimed to measure

factor
an underlying dimension or influence

factor analysis
a statistical technique which identifies underlying dimensions in a set of measures by finding groups of items which vary between individuals in similar ways

factorial validity
a form of construct validity in which the proposed constructs emerge as recognisable factors when data sets of item responses are factor analysed

formative assessment
evaluation carried out in the course of an activity in such a way that the information obtained is used to improve learning and/or instruction

global
not interested in detail; holistic

haptic
perceiving through physical contact

holistic
perceiving a whole object or focusing on the organic nature of a system

inductive
reasoning from particular facts to a general conclusion

internal consistency (reliability)
the degree to which the items in a test measure the same thing, measured by the average correlation between each item and the other items

inventory
detailed checklist

item analysis
a process for identifying good items in a scale, usually those which have at least a moderate positive correlation with the scale as a whole

kinaesthetic
perceiving through an awareness of body movement(s)

loading
in factor analysis, a correlation coefficient between an item and a factor

meta-analysis
the process of synthesising a range of experimental results into a single estimate of effect size

metacognition
awareness and conscious use of the psychological processes involved in perception, memory, thinking and learning

parameter
a factor that defines a system and determines (or limits) its performance

pedagogy
theoretical and procedural knowledge about teaching

percentile
a point on a scale below which a given percentage of a population will score

perception
interpreting and understanding information received through the senses

predictive validity
the extent to which a set of scores predicts an expected outcome or criterion

psychometric
concerned with psychological measurement

reliability
the coherence (internal consistency) of a set of test items, or the stability (test–retest) of a set of test scores over time

serialist
step-by-step: sequential (in Pask's theory)

summative assessment
evaluation of performance carried out at the end of a piece of work

tactile
perceiving through the sense of touch

test–retest reliability
the stability of test scores as indicated by retesting the same group and calculating a correlation coefficient using the two sets of scores

trait
a stable personal quality, inherited or acquired

validity
the quality of being well grounded in reality

variance
variability of scores in relation to their average (mean) value

How to contact the LSRC

The LSRC welcomes continuing interaction with researchers and research users. Please contact us with your questions, ideas and information.

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