

Learning styles in the classroom: Educational benefit or planning exercise?

Sarah J. Allcock & Julie A. Hulme

Differentiation of teaching is encouraged to accommodate student diversity. This study investigated whether using learning styles as a basis for differentiation improved A-level student performance, compared to differentiation on the basis of academic ability.

Matched classes of A-level psychology students participated. In one class, learning activities were differentiated by academic ability; in the other class, learning activities were differentiated by learning style for nine weeks, followed by a further class test. Student understanding of learning styles was also investigated.

Both classes significantly improved from baseline to final test, but there was no significant difference in improvement between the two groups, and indeed a slight trend for more improvement following differentiation by ability. Further research into personalised learning is required, and suggestions are made for a student-focussed intervention to enable students to better understand and to employ their own learning styles as a tool for independent study.

Keywords: *Differentiation; learning styles; personalised learning; diversity; classroom delivery; multiple intelligences; approaches to learning.*

THERE HAS BEEN a recent shift towards an increasingly 'personalised' approach to teaching and learning; that is, 'tailoring teaching and learning to individual need' (DFES, 2001) where inclusivity for learners is key (Rayner, 2007). Throughout the last 30 years, this approach has incorporated learning styles theory which stems from the belief that learners differ in personality traits, brain function and preferred environment (Coffield et al., 2004a), leading to varied strengths and weaknesses in receiving, assimilating and retaining information. The claim is that knowing one's preferences will improve motivation to learn and/or provide opportunities to approach learning appropriately (Honey & Mumford, 1992).

Many educational institutions diagnose student learning styles with the aim of planning lessons to suit a range of methods of learning. This approach is supported by professional bodies, for example, the Qualifications and Curriculum Authority (QCA) state that learners should be made aware of

their preferred learning style in order to improve performance (QCA, 2009). Some highlight the benefits of such practice for students, for example improving retention (Halstead & Martin, 2002). Others feel the theoretical basis for learning styles use lacks clarity (Klein, 2003) and the absence of substantial empirical research leaves questions about the effectiveness of the approach (Burton, 2007). It has been suggested that a lack of understanding of the theoretical underpinning of policy related to learning styles, along with a diverse literature adopting different theoretical approaches, is problematic for practitioners in terms of effectively planning personalised learning opportunities (Coffield et al., 2004a).

Due to the pedagogical popularity of learning styles, diverse literature has been produced, including variations on the theme in cognitive styles, multiple intelligences, approaches to learning and more. Desmedt and Valcke (2004) found recurring themes and consistency in models but little information on the impact of the concepts they

reviewed. The complexity of the area creates difficulty for practitioners in identifying which theory or model is appropriate for their needs (Cassidy, 2004). Coffield et al. (2004b) argue that most research in the last 30 years was carried out in higher education or workplace settings and does not refer to further education (FE) colleges. This is a problem for FE teachers looking for good practice.

The most widely known and used theory (Learning and Teaching Scotland, 2007) in education is Gardner's Multiple Intelligences (1993, 1997). While not strictly about 'learning styles', Gardner suggests seven intelligences possessed in differing degrees by individuals, implying a multitude of ways to introduce a concept to learners. The theory rejects traditional educational focus on logical-mathematical and linguistic skills and suggests that all students are intelligent in different ways, so should be taught through an inclusive curriculum. The intelligences proposed by Gardner include linguistic intelligence and logical-mathematical intelligence, which he identified as the conventional 'academic intelligences'. Others include bodily-kinaesthetic intelligence, musical intelligence, naturalistic intelligence and spatial intelligence, and the personal intelligences (interpersonal and intrapersonal intelligence). In educational application, Gardner suggests that individual intelligences should be assessed and the skills needed for learning about a topic identified. The educational programme should then be made as specific as possible to each individual (Gardner, 1993). This should be done by matching teaching to learning style and approaching a new topic in at least five different ways so that all learners can access the information (Gardner, 1991). This theory provides opportunity for personalising learning, although a practical way of effectively applying this kind of teaching to an average classroom is not clear (Burton, 2007); however, many teachers are expected to consider all intelligences in lesson planning (Reece & Walker, 2007). Gardner

admits the theory is easy to apply to individuals but difficult in classroom use which was not his original aim for the theory (Gardner, 1993). It is not necessary to design every lesson in many different ways, just to create experiences that different students can access (Moran, Kornhaber & Gardner, 2006). This means including activities and entry points that relate to a variety of intelligences throughout a topic.

Coffield et al. (2004a) carried out a large-scale review for the Learning and Skills Research Council and identified 71 models, 13 of which were categorised as major models in education. These 13 models were then reviewed on their reliability, validity, evidence and pedagogical implications, in particular the impact on FE students. Honey and Mumford's (2006) approach centred on developing student focus on learning, and proposed that learners should use their questionnaire to set their own targets for improving weaker learning styles and to increase awareness of how to use learning styles effectively. Coffield et al. praised this approach and identified development of students' awareness of their strengths and weaknesses as a main recommendation for the use of learning styles – as a way to explore pedagogy and create open discussion for study skills. As most research was found to be based outside psychological concepts or on small samples with an uncritical approach, Coffield et al. 'advise against pedagogical intervention based solely on any of the learning styles instruments.' (Coffield et al., 2004a, p.58).

These views are echoed by Hadfield (2006) who found overlap between models although little agreement on how they should be classified, causing difficulty for practitioners choosing which models to adopt. Hadfield states that when choosing a model, practicality for application to teaching based on each task and the availability of resources should be considered. Hadfield identifies three options for implementing learning styles in the classroom: matching teaching style and task to learner

preference; covering a range of styles over the course of a topic so learners sometimes encounter their preferred style; and varying teaching strategies with thinking skills to help learners adapt to other styles.

There is disagreement regarding which strategy is most effective; for example, Denig (2004) claims that students learn more effectively when teaching matches their primary or secondary preferred learning style, and Slack and Norwich (2007) found 'significant gains' in performance when teaching style matched learning style. Honey and Mumford (1992), however, suggest that learners should know how to use their preferred style but aim to improve their weaker styles in order to become a more rounded learner. It is suggested that all people can learn in all styles and although they may have a preference for one style, the best learning comes from experiencing a range of styles and strategies (Petty, 2004). Mokhtar, Majid and Foo (2008) found that students grouped by homogeneity in learning style, using an inventory based on McKenzie (1999) and Bohmer (2004, in Mokhtar et al. 2008), made the most improvement in performance on a project using information literacy. They also found, however, that all students given specific information literacy training made significant improvement in performance in comparison to those given no training, regardless of grouping. Halstead and Martin (2002) also found that students grouped by homogeneity of learning style (using Honey and Mumford's learning styles questionnaire, 1982) performed at a higher level on a group task than those who self-selected their groups. This could be simply a result of students taking a task more seriously if grouped by a teacher. Slack and Norwich (2007) report significant gains in key stage two spelling when teaching style was matched to learning style based on outcome of an inventory by Smith (1998, in Slack & Norwich, 2007). Slack and Norwich acknowledge that the experimental group consisted of students who had scored particularly

highly on visual or auditory preferences on the inventory used and that similar gains may not be shown for students showing less extreme preferences.

In contrast to research highlighting the advantages of learning styles models, other studies show little or no benefit of teaching based around learning styles. Davis and Franklin (2004) compared student self-reported learning styles preferences with performance before and after teaching using learning styles-based tasks. Little improvement was found and it was concluded that what students say they prefer may not be what is actually most effective for them. This highlights a problem with the self-report method of most learning styles inventories as students may misunderstand what is asked or report tasks they enjoy, rather than those they learn effectively from. Students may be aware of their learning preferences but may not relate these to teaching methods or may give inaccurate or contradicting responses to inventories (Prashnig, 2005).

Reviews of research into learning styles reveal little support for the theory in education. Kavale and Forness (1987) found that overall there was no positive or negative impact of tasks based on matching teaching style to learning style. Muse (2001) reviewed results of several learning styles studies in terms of their methodology and vested interest of the researchers. He concluded there were too many extraneous factors to assume that it was the use of learning styles that increased scores. For example, sample sizes tended to be small, outcomes were based on short-term improvement and validity of inventories used was not investigated. Muse also reports no real connection between learning styles identified and the teaching approaches suggested as appropriate for use with those styles. The approaches suggested were no different to techniques that are commonly used in teaching in general, for example, teacher led discussion or visual aids. Muse found no explanation of how these techniques were meant to specifically access certain learning styles.

The lack of connection between teaching approach and learning style is a common theme in much of the research because, as Hall (2006) points out, learning styles theory is not explicit to teaching and few models give practical suggestions for use within teaching. It would be a disservice to students to present them with teaching and learning exercises based on a theory hailed as good practice (O'Neill, 2003) when the teacher has no real framework to ensure these exercises are a valid tool. Some attempts have been made; for example, Honey and Mumford (2006) give a range of task styles that may be preferred by and that would not complement each learning style, and Kornhaber, Fierros and Veenema (2004) present a number of examples of 'ways in' to a topic to appeal to a selection of learners. Even as advocates of multiple intelligences theory, however, Kornhaber et al. state that it is not always possible to reach all intelligences.

In order to reduce misunderstandings and 'oversimplification' of use in education, Hall (2006) suggests that anyone applying learning styles should seriously engage with the theory, contrary to the current application where the ideas have become so mainstream they are often adopted without question (Coffield et al., 2004a). It is understandable that the time-pressured classroom teacher will use a tool recommended by their institution and OFSTED, making the need for rigorous study of recommendations essential.

Teachers are generally discouraged from labelling students (e.g. on the grounds of ability), and yet are encouraged to label students as 'visual' or 'kinaesthetic' learners (Burton, 2007). Students may interpret their diagnosis as meaning they can only learn in one way so have an excuse to not engage with tasks relating to other learning styles. Another risk is that it may be (unintentionally) implied that one style is less desirable than another, particularly if one style is underrepresented in a class. Hall (2006) argues that learning style theories can be useful and beneficial to provide important ideas about learning although instruments

can be misused resulting in limitation of learners. She advises, therefore, that the quality of use depends on the quality of diagnosis and feedback on styles.

There are positive aspects of using learning styles theory in education which are agreed by a number of researchers, for example, identifying and addressing individual learning needs and creating 'self-awareness' of learners, along with informing a range of learning and teaching methods (Coffield et al., 2004a). Halstead and Martin (2002) suggest creating a culture of engaging teachers and learners in the learning process to shift the focus from teaching methods to the methods of learning (Honey & Mumford, 2006) and to allow students to understand they are intelligent in more than one way (Moran et al., 2006). It is questionable, however, whether there needs to be such a focus on applying learning styles theory in the formal sense. As Rayner (2007) states, good teachers 'intuitively' respond to individual learner needs by finding the way students respond best and challenging them to adapt in different ways. His suggestion is that learning theory should be inclusive through adopting diverse strategies.

Klein (2003) challenges the idea that approaching a task through various activities is successful due only to differences in learning style. He proposes instead that it in fact fulfils 'different curricular goals' as different activities provide cognitive skills not available through a single approach. Klein gives the example of creating ownership through students transforming information from one format to another to present it in their own way. This supports Craik and Lockhart (1972) who suggest that elaborative rehearsal involving deep analysis of a stimulus may lead to improved long-term memory. This may explain why some students perform better when taught against their preferred learning style. Other methods of differentiation, such as differentiating material by ability (academic achievement) are well used by teachers and are advocated in teacher training as essential

practice (DfES SEN Code of Practice, 2001). These more traditional methods may become overlooked in favour of learning styles but may be equally of value to teachers and students (Gregory & Kuzmich, 2004).

Empirical comparison of outcomes using learning styles or other methods to inform teaching and learning is, therefore, essential. If learning styles are no more (or less) effective than other methods it would suggest that educational policies need to be reviewed. Further research is essential for continued discussion and questioning of pedagogical techniques to inform good practice (Rayner, 2007).

The current study empirically tested performance of A-level psychology students before and after intervention of lessons differentiated either by learning style or by ability. The learning styles models used were Honey and Mumford's Learning Styles Questionnaire (2006) and Gardner's Multiple Intelligences (1993). These models are sufficiently contrasting to facilitate accommodation of diverse student needs within the classroom from different perspectives, and are also commonly used within UK classrooms. It was expected that students who were taught using differentiated teaching methods informed by learning styles theory would differ in test performance relative to students who were taught using differentiated teaching methods informed by prior academic ability. It was also considered important to investigate how students actually understand and utilise the information they are given as a routine part of their course of study.

Method

Design

A 2x2 mixed design was employed to measure the effects on test scores before and after teaching through differentiation by learning style, or differentiation by ability. Lesson plans and materials were created for each lesson, checking that tasks were of a similar level of challenge and that similar skills were accessed for each condition.

All lessons were planned prior to the experimental period to ensure that all learning styles/intelligences were equally represented and that tasks related to each preference based on suggestions given in previous research. The scheme of work was structured so that Honey and Mumford's learning styles and Gardner's multiple intelligences were represented in alternate lessons, or where a task continued beyond one lesson, in alternate tasks. This was to ensure that lessons were varied and stimulating.

The questions and mark scheme used in the pre- and post-tests were based on the A-level specification mark scheme and were approved by professional peers. Both groups were taught by the same teacher and received the same tests, inventories and initial questionnaires. The final questionnaire differed in that the main focus was on the type of differentiation received (by learning styles or ability). Students were asked not to discuss content of materials or lessons with students outside of their own teaching group.

Participants

Thirty-three A-level psychology students from two classes at a Further Education college in the north-west of England initially consented to participation in the study; however, due to absence from class for testing, five students were omitted from the final sample. No students declined to participate or withheld consent. Students were taught by their usual teacher (the same for both groups) according to their normal timetable in their usual classes over the experimental period of three weeks (nine lessons, 13.5 hours in total). The A level specification was followed as normal as students prepared for their A level exams.

Students were 17- to 19-years-old, 12 males and 21 females (10 males and 18 females in the final sample) with a range of minimum target grades from A to C. Performance grades prior to the study ranged from A to D. Achievement and gender split were similar

across both classes. Classes were allocated to intervention condition (differentiation by ability vs differentiation by learning style) at random by the toss of a coin. The differentiation by learning style group contained 16 students and the differentiation by ability group contained 17 students.

Materials

Students were given a consent form outlining the purpose and ethical considerations of the study. Although students were above 16 years, as they were in full-time education, a similar letter was given to parents/guardians requesting negative consent.

A test of comprehension, description and analysis of a recently taught topic was given prior to the start of the intervention teaching. This contained questions structured in a similar manner to an A-level exam. An unfamiliar question was included to test critical evaluation skills. Participants completed a questionnaire relating to their understanding of learning styles theory and preferred activities experienced in lessons.

Participants were also given two learning styles questionnaires; Honey and Mumford's Learning Styles Questionnaire (Honey, 2006); and a questionnaire created for this study designed to diagnose strengths of Gardner's Multiple Intelligences. This questionnaire was written according to Gardner's (1993) descriptions of preferences including statements relating to extra-curricular activities. Test-retest reliability for this sample was found to be high (90.88 per cent). The two questionnaires were chosen to represent two opposing approaches to learning styles; Honey and Mumford believe learning styles are learnt, so flexible and changeable, while Gardner believes learning styles are fixed, based on biological traits. After the teaching intervention, participants were given a test on one topic taught during the intervention period which followed the same structure as the pre-intervention test. Participants also completed a questionnaire relating to their experiences during the experimental

period, their understanding of learning styles theory and their future study intentions relating to their learning styles.

Procedure

Participants were briefed on the aims and intentions of the study with particular focus given to the positive implications for lesson planning after the study; that all students would benefit from the inclusion in future lessons of methods found to be effective. Students were reminded that they took part voluntarily and that withdrawal would have no negative effect on their learning experience.

In the lesson prior to the start of the study, participants completed the 50-minute pre-test in test conditions. They then completed the pre-intervention questionnaire on learning styles knowledge and preferences. Each inventory was explained in terms of theory and intentions then outcomes were recorded for each student. Explanations were given of the implication of those outcomes for how students prefer to learn in a practical context. Each class was then informed which condition they would be in and what the structure of the experimental period would be.

Over the next nine consecutive timetabled lessons, students were taught topics according to the scheme of work through lessons differentiated by learning style or ability. In the differentiation by learning style condition, individual students were given tasks appropriate to their strongest styles or were grouped by style. In the differentiation by ability condition, students were given ability-appropriate tasks or were grouped according to their strengths on specific skills. Both classes covered the same topics in their respective lessons and spent the same amount of time on each activity; only the methods of delivery and learning tasks were varied. Students were informed at the start of the study which topic the post-test would relate to. Independent study was set according to departmental policy, again with variations on tasks set

according to condition. The 50-minute post-test was administered in the same conditions as the pre-test, in the lesson immediately after the experimental period. The post-intervention questionnaire was also completed. A full debrief was given to each group detailing the aims and expected outcomes of the study along with the opportunity for questions. Advice was given on how to use their experiences to improve independent study techniques. Participants were fully debriefed and given an opportunity to ask questions.

Results

The initial assessment of learning styles across the two groups revealed that in both groups, the dominant intelligence (Gardner, 1993) was musical intelligence, with logical-mathematical intelligence also being prominent. Activists, reflectors and theorists (Honey, 2006) were all found in both groups, with pragmatists being the dominant learning style. Chi square analysis (results not presented) revealed no significant difference on either measure across the two conditions ($p > .05$).

Means were calculated for performance on the pre- and post-intervention tests for both conditions. Table 1 shows the means and standard deviations for each condition.

Test scores were consistently higher for the differentiation by ability condition than the differentiation by learning style condition and the former increased their average score by slightly more on the post-test although there was greater deviation in these scores compared to the experimental condi-

tion. It can be seen that the total average increase in scores was nearly 3.5 marks – one grade – between pre- and post-testing; however, the standard deviation of each condition increased on the post-test scores indicating more variation in individual achievement.

The data were subjected to a two-way mixed analysis of variance to determine whether there were any significant differences reflecting the effects of time and differentiation method on improvement in scores and the interaction between differentiation methods on differences between scores. Figure 1 (overleaf) shows the profile plot for differences in scores for each condition.

Within-participant effects:

A significant main effect was shown for difference in scores over time; $F(1,26)=7.83$, $p=0.01$, however, no significant interaction was shown for method of differentiation on differences between scores; $F(1,26)=0.10$, $p=0.76$, $\eta^2=0.004$.

Between-participant effects:

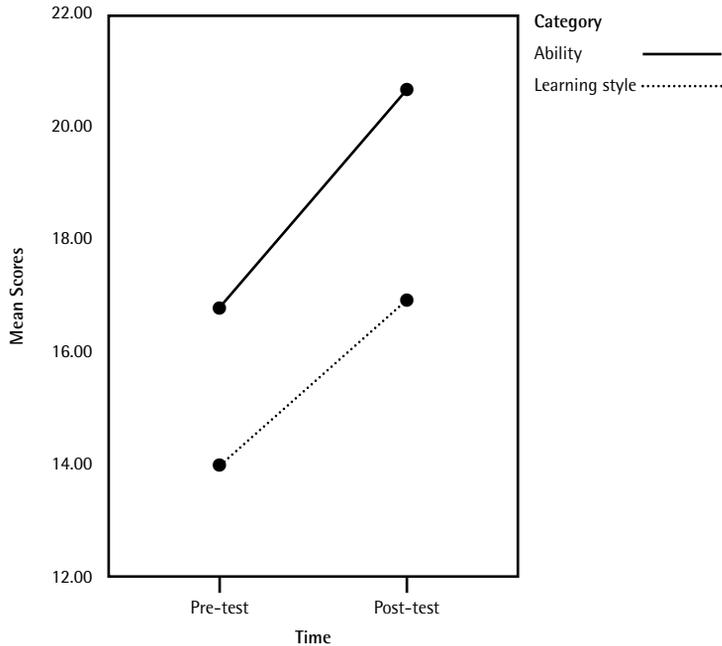
There was no significant effect shown for method of differentiation on improvement in performance; $F(1,26)=3.02$, $p=0.09$, $\eta^2=0.10$.

This is a medium effect size according to Cohen (1988), and suggests that with a slightly larger sample size (16 per group), an effect of differentiation method may be observed, with improvement highest when differentiation is by ability (Clark-Carter, 2003).

Table 1: Mean test scores and (standard deviations) for conditions pre- and post-intervention.

Method of differentiation	Pre-test (Maximum score 28)	Post-test (Maximum score 28)	Change in Mean score
Ability $N=13$	16.85 (5.47)	20.69 (6.85)	+3.84
Learning style $N=15$	13.93 (5.65)	17.00 (5.92)	+3.07
Total	15.29 (5.66)	18.71 (6.52)	+3.42

Figure 1: Profile plot of mean scores for differentiation by ability and differentiation by learning style conditions pre- and post-test.



Student information and attitudes

Understanding and use of learning styles prior to intervention:

Prior to the intervention, 11 students in the differentiation by ability group and seven students in the differentiation by learning style group were able to report their learning styles, all based on Gardner's (1993) multiple intelligences. Only four students across the cohort could name Gardner's multiple intelligences as one of the tools used and only two students could name one other method.

There were consistent explanations of why learning styles were used by teachers but all were simple, relating to students having different preferences; for example, 'because different people learn differently'. When asked what kind of tasks were known to meet different learning styles, some students attempted to assign a learning style to an activity (for example, 'mind maps for visual learners') while others cited a range of different teaching and learning activities

without explanation of how they fit in to learning styles.

Fifteen students in total reported that they think about their learning style in independent study although it is questionable whether this was using a preferred learning style or simply activities they found successful in the past.

Understanding of learning styles after the intervention:

After the intervention, the differentiation by learning style group showed a more developed understanding of the purpose of learning styles in education – one student in this group said they were used 'To support all people learning as different people may have different attitudes towards learning or different methods of understanding and this theory enables differentiation between groups of people'. The differentiation by ability group remained general in their explanations. Each group, however, explained more about 'learning' rather than

‘teaching’ in the post-intervention questionnaire suggesting that students had considered their own responsibility in their learning as well as that of the teacher. All but one student was able to report their learning style (on both inventories used).

Enjoyment and usefulness of activities:

When asked about the activities experienced, both groups reported enjoying the variety of activities used. Students in the differentiation by learning styles group were critical of always matching the activities to their strongest learning styles; one student commented that regardless of their preferred style, some tasks need different approaches. The most positive student comments from the differentiation by learning styles group were received for a group presentation task requiring them to consider a variety of learning styles for their audience (six out of 15 students reported this as the most enjoyed task).

Each group rated the usefulness of teaching activities used in their intervention lessons (where one was not at all useful and five was very useful) and were asked to rate how learning styles should be used in lessons (where one was completely disagree and five was completely agree). Table 2 shows the mean ratings given by each group.

These ratings show students in each group felt learning styles had a place in the classroom but did not feel they were appropriate as the main tool. There was no significant difference in reported usefulness of learning activities between the two groups ($U=89, p>0.05$).

Discussion

Students showed a significant increase in test scores on the post-intervention test regardless of method of differentiation, therefore suggesting that teaching itself had an effect on performance over time. The method of differentiation did not produce any difference in improvement, although there may have been a slight trend for students differentiated by ability to improve more. This supports the research of Kavale and Forness (1987) who found no positive or negative impact of tasks based on preferred learning style. This suggests that as long as teachers plan good quality, varied lessons with ways for all students to access the information, students can achieve without one method being superior to another. These findings support those of Muse (2001) in that increase in scores in this case was not due to learning styles but the process of teaching in general.

Table 2: Student ratings of activities and learning styles use by condition.

Group	Average rating of usefulness of techniques (max. 5)	Average rating of how learning styles should be used in lessons (max. 5)		
		As the main tool	As a variation with other techniques	Not necessary
Differentiation by ability	3.75	2.73	4.27	1.67
Differentiation by learning styles	3.30	2.80	4.20	2.07

Results suggested that learning styles inventories were used but students did not understand why learning styles theory in particular was implemented to address individual differences in learning. Students also misunderstood how teaching and learning activities correspond to addressing preferences in relation to learning. This may represent learning styles being misunderstood from teachers' points of view and may lead to students being misguided in the activities they choose in their independent study. Responses from students suggest that they understood there are individual differences in ability and preference in A-level classes and that differentiation in teaching style and materials is necessary to ensure all students can achieve. Students reported that they preferred a variety of teaching methods to be used and they responded best to lessons that were varied in teaching and learning activities and challenges. This reflects the limitations of learning styles application (Burton, 2007). The lack of variety of groupings and approaches was an issue for students differentiated by learning style as all their lessons were based around these diagnoses. This supports conclusions reached by Davis and Franklin (2004), in that it is difficult to restrict the use of learning styles in a classroom environment. As they state, there are a multitude of factors which interact to create learning; stimulation and enjoyment of tasks must be a factor. Students' feelings of restriction to one approach may have contributed to the lack of effect of learning styles-based differentiation. Students differentiated by ability experienced more variety as they were grouped according to aptitude for specific skills, which differed by task. Previous research shows consistency with this situation, for example, Smith (2002) states that students are reluctant to change their methods of learning simply due to the outcome of a questionnaire. The differentiation by ability group was more familiar with the methods used so reported more satisfaction.

As differentiating by learning style did lead to some improvement in achievement by students, there is some support for research reporting the positive outcomes of teaching by learning style. Mokhtar et al. (2008), Halstead and Martin (2002) and Denig (2004) all found that students performed at a higher level when taught in homogenous groups according to learning style. The current findings are consistent with this approach being accepted as appropriate as one teaching and learning strategy. This is in contrast to the claim that teaching according to primary learning style cannot facilitate learning of the curriculum (Burton, 2007). These results, however, cannot be compared to those of research where students were taught against modality as only one task given to the group differentiated by learning style required them to consider other learning styles. This was, however, the task that received the most positive student comments relating to enjoyment and usefulness, consistent with allowing learners to engage with their less preferred styles in order to become more rounded learners (Honey & Mumford, 1992; Davis & Franklin, 2004). There is a need for more research into teaching against learning style preference as this may improve aspects of learning such as developing the range of learners (Coffield et al., 2004a) and increasing motivation and enjoyment.

Matching teaching to learning styles can be difficult due to the lack of guidance available in the literature. Some tasks may have lacked connection to the intended learning style due to unintended influence from the teacher's own style. This could have been rectified by contributions towards planning from other staff with different learning style preferences. This issue would be particularly prominent in tasks based around Gardner's Multiple Intelligences (Gardner, 1993) as there were no clear guidelines given for appropriate types of tasks, unlike for Honey and Mumford's Learning Styles Questionnaire (Honey, 2006). Issues with the inventories themselves would have carried through

this study, for example,° low internal consistency identified in Honey and Mumford's Learning Styles Questionnaire (Coffield et al., 2004a). Students were also grouped according to their strongest style on this inventory when in reality most had strong preferences for more than one style.

Conclusions drawn from the findings, considering the difficulties of conducting empirical research in this area, are that learning styles are only one part of effective teaching and learning. They should be included as part of a varied and personalised approach by teachers but not exclusively. Planning lessons based around learning style preferences is no more effective for student achievement than planning lessons based around differences in academic ability. Therefore, educational institutions that have accepted learning styles theory without rigorous testing should consider whether it is really essential to diagnose student learning styles as a matter of course. Other teaching and learning techniques should be considered and employed in order to personalise learning in different ways and provide each individual student with the most effective learning experience. There should be further research into other techniques such as thinking skills and increasing motivation. Regarding learning styles, there is potential for future research into their use as a tool for

students' independent study – to convert material into their preferred formats in order to help them engage with material and their own learning. The primary area for further research into providing the most effective teaching and learning techniques would be into the use of approaches that allow students to address and reflect on their own learning strengths and weaknesses. There is a role for learning styles as part of this to provide a base from which students can engage with their own learning in order to become independent, effective learners.

Correspondence

Sarah J. Allcock

School of Social Science,
Runshaw College,
Langdale Road,
Leyland,
Lancashire PR25 3DQ.
Tel: (01772) 622677
E-mail: allcock.s@runshaw.ac.uk

Dr Julie A. Hulme

Department of Psychology,
Staffordshire University,
College Road, Stoke-on-Trent,
Staffordshire ST5 3AT.
Tel: (01782) 294674
E-mail: j.a.hulme@staffs.ac.uk

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