# Educational Research

Evaluating the reliability and validity of a learning styles inventory: a classroom-based study

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# Evaluating the reliability and validity of a learning styles inventory: a classroom-based study

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*Background*
Psychology and educational theory has a long tradition of research into learning styles. However, the current educational policy and practice interest in learning styles in the UK has resulted in concepts and practices being adopted with little rigorous empirical evaluation.
*Purpose*
This small-scale, experimental study aimed to test the reliability and validity of an available inventory designed to identify learning styles (visual, auditory and kinaesthetic).
*Sample, design and methods*
Nineteen children, aged 7–10 years, with different styles as identified by the inventory, participated in a class experimental evaluation of their differential response to the teaching of word spelling using different teaching methods.
*Results*
The study found that the visual and auditory scales, but not the kinaesthetic scale, were reliable (internally and re-test). The three groups of pupils with different learning styles—visual only, auditory only and mixed visual and auditory—showed different gains to teaching that matched these styles (visual and auditory teaching approaches). Retention of word spelling was higher one week after the teaching when the teaching matched the learning style.
*Conclusions*
The findings in this exploratory study suggest the significance of learning style for classroom-based teaching.

## Introduction

Though there has been a long tradition of psychological and educational theory and research about learning styles (Cassidy, 2004), it is only more recently in the UK that there has been education policy and practice interest in what these ideas can offer the school system. The policy context of this rediscovery of learning styles is the UK

government commitment to raise standards for all. This inclusive commitment implies that teaching needs to find ways of enhancing learning and attainment for those who might not have responded to uniform and conventional forms of teaching and learning. In this context, individuals are seen to differ in their ways of learning and this is seen to call for different ways of teaching that take account of these individual differences. Current UK government policy for primary schools refers to all pupils achieving their maximum potential (DfES, 2003), and this inclines professionals to be open to ideas and practices that support differentiation in teaching approaches that respond to these learner differences. A further example of this trend is in the adoption within the English National Curriculum and National Strategies (QCA, 2006) of practices associated with a contemporary theory of learning styles based on the work of Gardner (1993).

Teachers' receptiveness to ideas and methods derived from psychology is often influenced more by perceived practical relevance than the conceptual or empirical soundness of the contribution (Norwich, 2000). This applies to the current interest in learning styles, where concepts and practices have been disseminated and adopted without much rigorous empirical evaluation. Inventories that are supposed to identify learning styles are disseminated to and used by teachers, without any quoted evidence about the validity and reliability of these measures of learning style (Lazear, 1991; Smith, 1998; Smith & Call, 1999). This situation has continued for well over a decade, as shown by similar criticisms by Riding and Rayner (1998). Practical methods of differentiating teaching methods to take account of these different learning styles have become the subject of much professional development activity in the UK and internationally. However, there have been few systematic empirical studies of enhanced attainments following teaching methods selected to match identified learning style. In this paper, we present findings from a school-based experimental evaluation of learning outcomes associated with differential teaching of spelling based on visual and auditory learning styles. The first part of the study involved testing the reliability of an inventory, which is widely available and used to identify visual, auditory and kinaesthetic learning styles (Smith, 1998). The second part involved identifying children in terms of their visual and auditory styles and then examining their spelling gains in response to auditory and visually orientated methods of teaching spelling.

## Theoretical background

Learning style is a dispositional or trait concept in that it is about how someone usually approaches learning—that is, how they learn. It is not about a state, a specific way of learning particular skills or knowledge. Attributing a learning style enables some generalization across different learning situations and over time, and is therefore useful, in principle, for planning appropriate teaching. It differs from general or specific cognitive abilities, which are about differential capacity for learning and attainment. Since learning styles are seen as independent of cognitive abilities, this opens up possibilities for teaching which can impact on learning and attainment across the ability range. This aspect explains, in part, the renewed interest in learning styles. Learning style has also been associated with allied terms, like cognitive style and learning strategy. The use of cognitive style has a more general focus in referring

to individuals' typical or habitual general mode of cognitive processing (problem-solving, thinking, remembering, etc.), while learning style is more focused on typical modes in learning situations (Riding & Rayner, 1998). Learning strategies are also distinguished from learning styles in referring to strategies that learners select to deal with specific learning activities (Hartley, 1998). The implication is that style is more habitual and automatic, while strategy is more about optional and variable approaches. Learning strategy has *state* qualities, while style has *trait* qualities.

Curry (1987) has integrated these notions into an 'onion' model with four layers. The outer layer is described as 'instructional preference', by which is meant the learners' preferred choice of learning environment, including activities and setting. It is the most observable and open to influence. The next layer is described as 'social interaction' referring to the kind of social interaction during learning. These include types and levels of interaction such as collaborative versus competitive and participant versus avoidant. The third layer is termed 'informational processing style' and represents the person's intellectual approach to processing information. This layer involves more stable dispositions. The innermost layer is described as 'cognitive personality style' and represents the most stable personality dispositions that relate to behaviours across a range of situations (see Table 1).

In a more recent attempt to integrate different conceptions about learning styles, Rayner and Riding (1997) identified three types: learning-centred, cognitive-centred and personality-centred approaches. Learning-centred approaches relate to those conceptions that relate directly to learning in educational settings. These authors consider three kinds of learning-centred approaches:

1. process models;
2. preference-based models;
3. cognitive skills models.

From an analysis that compares Curry's 'onion' and Rayner and Riding's (1997) three-way typology (Cassidy, 2004), it is clear that Rayner and Riding's

Table 1. Summary table of relationships between the Curry (1987) and Rayner and Riding (1997) models of approaches to learning

|  | Curry model | Rayner & Riding model |
|---|---|---|
| More observable/open to influence | 1. Instructional preference | 1. Learning centred<br>i. process models; |
|  | 2. Social interaction | ii. preference-based models; |
|  | 3. Information processing style | iii. cognitive skills models |
|  | 4. Cognitive personality style | 2. Cognitive centred |
| More stable |  |  |
|  |  | 3. Personality centred |

learning-centred approaches put together the three outer layers of Curry's onion model (see Table 1). What Rayner and Riding call cognitive-centred approaches (their second type), correspond to Curry's cognitive personality inner layer. However, Rayner and Riding's third type—personality approaches—refers to an approach which explicitly focuses on personality. They consider that there is only one example of this approach, that is based on the Myers-Briggs model (Myers, 1962).

It is clear from this discussion of attempts to characterize higher-level kinds of learning styles that distinctions need to be made between styles that relate:

- to specific settings compared to a range of settings;
- to more variable compared to more stable dispositions;
- to more specific processes of learning compared to more general cognitive processes.

Curry (1987) discusses confusions over definitions and their implications, and concerns about the weaknesses in the reliability and validity of attempts to assess learning style. Other reviewers of the field also call attention to the lack of evidence of reliability and validity (Riding & Rayner, 1998; Cassidy, 2004). In this study, the focus is on a widely used model of learning style that is learning centred (in Rayner and Riding's typology) and about instructional preference, according to Curry's model. The model used by Smith (1998), which is the focus of this study, assumes that people differ in terms of preferring visual or auditory or kinaesthetic modes of learning. Smith presents it as a practical model, without much theoretical analysis that would help place it along with other historical attempts to characterize learning styles. In examining Smith's publication, we found no written account about how the inventory was developed, nor about its theoretical basis. In asserting the importance of these three kinds of learning styles, Smith links his proposals to Gardner's theories about multiple intelligences (Gardner, 1993) and a model of 'accelerated learning cycle'. Criticisms of the renewed interest in learning styles have focused both on the theoretical origins and justifications for the concept, and on problems of definition, measurement and assessment (Klein, 2003). Other authors have called attention to false labelling of children in terms of their learning styles. This includes over-generalization and ignoring mixed kinds of learning styles, so leading to false expectations and opportunities for learning (Schmeck, 1988; Reynolds, 1997). These criticisms underline the importance of the reliability of measures for identifying learning styles and their validity in being related to differential learning to different modes of teaching.

The specific research questions in this study were:

1. How reliable (over time and internally) is a published measure of learning style in terms of visual, auditory and kinaesthetic styles?
2. To what extent is this categoric typology of learning style applicable to a particular group of primary-aged pupils (5–11 years)?
3. Do children identified in terms of these learning styles respond differently to the teaching of spelling through different modes?

## Methods

*Design*

The study was conducted in two stages. In the first stage, the learning styles inventory was tested for reliability. In the second stage, based on the findings of this test, the inventory was used to identify a smaller sample of pupils with different learning styles and these were taught in their class to spell a list of words by two distinct modes. All children were taught by both methods while their spelling gains were monitored immediately after the teaching and then a week after the end of the teaching.

*Learning style inventory*

The inventory was developed on the basis of a widely disseminated version (Smith, 1998) to be completed by pupil self-report. This inventory only focused on Smith's visual, auditory and kinaesthetic styles, not the full set of styles based on Gardner's (1993) multiple intelligence model. There were six statements for each style and pupils had to respond 'yes' or 'no' to each statement which was read out to pupils in their classroom. See Appendix 1 for statements in the inventory and the learning style they indicate.

*Sample and setting for the study*

The study was conducted by the first author, a class teacher in a small school (160 pupils) in a town in south-west England. Children were taught in mixed-age classes in key stage 2 (the second phase of primary schooling from ages 7 to 11 years). The 51 children (21 boys and 30 girls) taking part in the study were from key stage 2 classes: one class ($n = 25$) covering ages 7–8 and the other ($n = 26$) ages 9–10. The school had about 25% of pupils identified as having special educational needs,[1] and there was a similar proportion of children with difficulties in learning in the sample (mostly for literacy difficulties), though the group included those with high attainments too.

*Evaluating reliability of the inventory*

The internal reliability of this inventory was judged in terms of the extent to which the statements relating to the three types of learning styles were intercorrelated, that is internally consistent. The sample size was too small to conduct factor analysis, but Cronbach's $\alpha$ was used as a measure of internal consistency. The stability of identifying pupils in terms of a specific learning style was judged in terms of the stability of style identification over a period of one week. Half the sample (25 pupils) completed the inventory a second time one week after the first completion.

Cronbach's $\alpha$ for the three scales (visual, auditory and kinaesthetic), each made up of six statements, are shown in Table 2. On the basis of these measures, it was decided that the visual and auditory scales were more internally reliable and stable than the kinaesthetic scale. The kinaesthetic scale was judged to have insufficiently high levels of reliability to be worth testing in the teaching experiment of validity.

*Identifying pupils with distinctive learning styles for the teaching experiment*

Satisfactory internal consistency and re-test reliability were found for only the visual and auditory styles. So, only these were used in the teaching experiment. From the 50 pupils, 19 pupils were selected to represent learning styles in terms of having high scores in one or both areas. A high score was taken as a score of 4 or more on the six-point scale (made up of 1 point for a positive response to each of the six statements in each learning style area). As there were high scores in the visual only area ($n = 6$), auditory only ($n = 7$) and high visual and auditory ($n = 6$), three groups participated in the teaching experiment. The remaining 32 pupils, who did not participate in the experimental evaluation, had low (0–1) to medium (2–4) scores in the two areas. Only the high scorers were included in the experimental teaching in order to evaluate the impact on those with more distinct learning styles. Table 3 shows the distribution of scores for the overall sample on the auditory and visual scales. This shows that pupils had a range of scores on each scale. Cross-tabulating the auditory and visual scores shows that for those with high visual scores ($n = 20$), 15 or 75% had low or medium auditory scores; and for those with high auditory scores ($n = 18$), 13 or 72% had low or medium visual scores. These patterns indicate that pupils did not tend to say 'yes' to all questionnaire statements about their styles of learning.

*Experimental teaching of spelling*

Spelling was chosen as the area for evaluating the validity of the learning styles identification because it was of particular relevance to the school's curriculum and

Table 2. Internal and re-test reliability coefficients for three scales

|  | Cronbach alpha $N = 51$ | Re-test reliability $N = 25$ |
| --- | --- | --- |
| Visual scale | 0.63 | 0.90* |
| Auditory scale | 0.75 | 0.96* |
| Kinaesthetic scale | 0.56 | 0.75* |

*Significant at $p < 0.05$.

Table 3. Frequency of scores on visual and auditory scales

| Scores | Levels | Auditory scale | | Visual scale | |
| --- | --- | --- | --- | --- | --- |
| 0 | Low | 4 | 12 | 5 | 9 |
| 1 |  | 8 |  | 4 |  |
| 2 | Medium | 4 | 21 | 1 | 22 |
| 3 |  | 14 |  | 14 |  |
| 4 |  | 3 |  | 7 |  |
| 5 | High | 8 | 18 | 18 | 20 |
| 6 |  | 10 |  | 2 |  |
| Total |  | 51 |  | 51 |  |

teaching plans. It was also an area that was open to experimental teaching. The sequence of testing and teaching in the experimental teaching was as follows (pupils in all three learning styles groups participated in the procedure):

1. a pre-test of the first set of words (who, girl, could, how, little, many, then, their, these, knew);
2. a 20-minute teaching session using the visual teaching method;
3. an immediate post-test with the first set of words;
4. a delayed post-test with the first set of words;
5. a pre-test of the second set of words (night, made, once, broke, catch, does, water, them, yellow, what);
6. a 20-minute teaching session with auditory method;
7. an immediate post-test with second set of words;
8. a delayed post-test with second set of words.

The 19 pupils came from the older and younger key stage 2 classes and represented the 7–10 age range. Table 4 shows the breakdown of age ranges for the three learning styles groups. Though there were children from the younger age group ($n = 6$) and the older group ($n = 13$), the visual and auditory groups had mainly older children and the mixed visual/auditory group mainly younger children. The two key stage 2 classes were reorganized for the evaluation, so that the selected 19 were taught as one group.

The words used in the two lists for pre- and post-testing were selected from previous class spelling assessments to be ones that were of comparable length and regularity of spelling and equivalent level of difficulty. This was confirmed in the pre-tests which showed that the mean scores for the group on both lists was less than one out of ten words (0.7 and 0.8 words), and nobody could spell more than two words in either list.

The visual method of teaching involved highlighting the 'tricky' parts of the words in some memorable ways. This included using colour, a small picture or by writing the word in a distinctive style. Pupils were encouraged to focus on each word and to try to recall what the word looked like, with special attention to highlighted or 'decorated' parts of the word that they found difficult. The teaching was led by the teacher, who went through the words one at a time, while involving the pupils in the highlighting process and in recalling the words. There was one teaching session of 20 minutes using this visual approach.

In the auditory method of teaching each word was segmented into syllables as a way of recalling how to spell the word. Where there were parts of words which were said

Table 4. Age breakdown of learning styles intervention groups

| | Visual group | Auditory group | Visual and auditory group | Total |
|---|---|---|---|---|
| 7–8 years | 0 | 1 | 5 | 6 |
| 9–10 years | 6 | 6 | 1 | 13 |
| Total | 6 | 7 | 6 | 19 |

differently from how they were spelled—e.g. night—pupils were encouraged to say the word aloud, saying it as it is written. For other words mnemonics were introduced where the spelling was unusual. As in the visual method, the auditory teaching was teacher-led with the teacher going through the words one at a time, while involving the pupils in the segmenting and recalling processes. The auditory teaching session was also of about 20 minutes.

### Assessing initial gains and delayed spelling gains

Pre-teaching spelling tests were conducted with each list, and then again immediately after the teaching sessions. Spelling tests were repeated again one week after the teaching.

### Data analysis

Quantitative data from the teaching experiment were entered in SPSS. Repeated measures analyses of variance were used to examine the differential impact of the two teaching approaches on gains in word spelling.

## Findings

### Gains in word spellings

Table 5 shows the means and standard deviations for the three groups for the visual and auditory teaching immediately after the teaching and at delayed testing. A repeated measures analysis of variance (ANOVA) was undertaken with one between-group factor (visual, auditory and visual and auditory), and two within-group factors: time (immediate and delayed testing) and teaching (visual and auditory modes). There was a significant decrease in the words spelled correctly from immediate to delayed testing, as shown in Figure 1 ($F = 70.0$, df $= 1,16$, $p < 0.001$).

There was also a significant interaction between teaching group and teaching mode ($F = 79.0$, df $= 2,16$, $p < 0.001$). Word spelling gains were highest when teaching mode matched learning style strength. Word spelling gains were highest for visual teaching in the order visual group, visual and auditory group and then auditory group. This was reversed for auditory teaching where the word gains were highest in the order: auditory, visual and auditory and then visual.

However, the main finding of an effect for teaching mode and an interaction effect for group by teaching mode are superseded by the three-way interaction between group $\times$ teaching $\times$ time of testing. This interaction was significant ($F = 6.5$, df $= 2,16$, $p < 0.01$). This three-way interaction is illustrated in Figure 2 which shows that the decrease in word spelling gain between the initial and delayed testing was least when the teaching mode corresponded to the strength of the group: visual teaching for visual and visual/auditory groups and auditory teaching for auditory and visual/auditory groups.

Table 5. Means and standard deviations of gains in word spelling for different learning style groups in response to visual and auditory teaching

| | Means (1 d.p.) and (standard deviations) (max. score 10) | Visual and auditory group $n=6$ | Auditory group $n=7$ | Visual group $n=6$ |
|---|---|---|---|---|
| Visual teaching method | Pre-test | 1.0(0.9) | 0.6(0.8) | 0.5(0.5) |
| | Immediate post-test | 8.8(1.0) | 7.0(0.8) | 9.2(0.8) |
| | Delay post-test | 8.3(1.0) | 5.1(0.4) | 8.7(0.8) |
| | Initial gain | 7.8(0.4) | 6.4(1.3) | 8.7(0.5) |
| | Delay gain | 7.3(0.8) | 4.5(1.3) | 8.2(1.0) |
| | Decrease in gain* | −0.5(0.8) | −0.9(1.0) | −0.5(0.8) |
| Auditory teaching method | Pre-test | 1.2(0.4) | 0.7(0.8) | 0.7(0.8) |
| | Immediate post-test | 9.0(0.6) | 9.1(0.7) | 7.7(0.5) |
| | Delay post-test | 8.0(1.1) | 8.1(0.7) | 7.7(0.5) |
| | Initial gain | 7.8(0.4) | 8.4(1.1) | 7.0(1.1) |
| | Delay gain | 6.8(1.0) | 7.4(1.0) | 5.0(1.0) |
| | Decrease in gain* | −1.0(1.1) | −1.0(0.8) | −2.0(1.0) |

*Significant at $p < 0.01$.
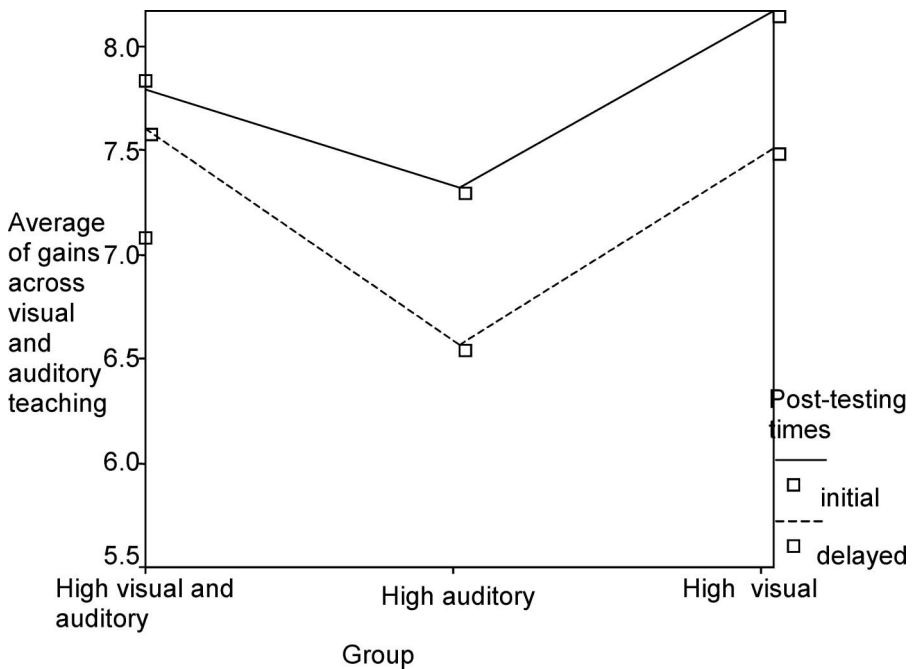


Figure 1. Average spelling gains for both kinds of teaching for three groups

Table 6 shows how many pupils in each of the three groups had higher gains by one or other teaching mode at both testing times. Of the visual group, four of the six pupils showed greater gains in response to the visual teaching at initial testing.
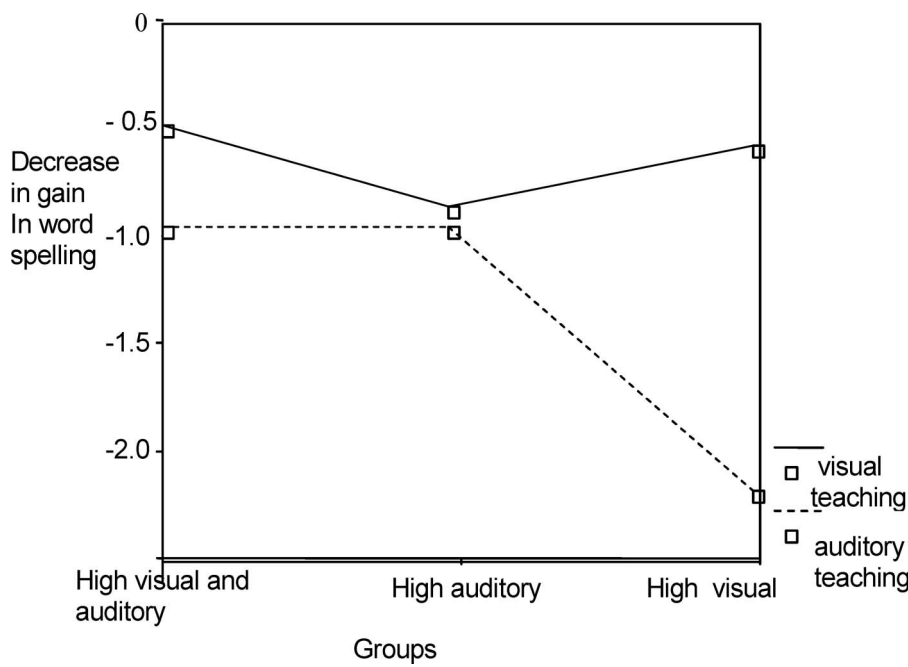
Figure 2. Decrease in gains in word spelling from immediate to delayed testing for visual and auditory teaching

Table 6. Numbers of pupils in the three groups where one or other teaching mode had higher word spelling gains initially and at delayed testing

| | Teaching modes | | |
|---|---|---|---|
| Groups | Visual > auditory | Auditory > visual | Auditory same as visual |
| Immediate test | | | |
| Visual | 4 | 0 | 2 |
| Auditory | 0 | 6 | 1 |
| Visual and auditory | 2 | 0 | 4 |
| Delayed test | | | |
| Visual | 6 | 0 | 0 |
| Auditory | 0 | 7 | 0 |
| Visual and auditory | 3 | 1 | 2 |

While there was no initial difference in gains for two of the six in the visual group, at delayed testing they too showed greater gains for visual teaching. A similar pattern was found for the auditory group, with greater gains in response to the auditory teaching for all at the second testing. For the visual and auditory group at the immediate testing, four of the six showed the same levels of gains for both teaching modes. At delayed testing, two of the pupils who responded similarly to both teaching modes at immediate testing now showed more gains in response to each teaching mode.

## Discussion and conclusion

This classroom-based study has shown that it is possible to evaluate systematically the reliability of a learning styles inventory and to examine differential responses to teaching. In terms of the different models of cognitive and learning style, discussed above (Cassidy, 2004), this particular inventory is focused mainly on learning preferences. This can be seen in the content of its statements (see Appendix 1).

However, the empirical testing does show that the kinaesthetic scale did not reach a satisfactory level of internal consistency. This can be understood by inspecting the six kinaesthetic items, most of which do not relate directly to the assumed learning mode. Two of the statements are about attention and motor control and one is about being good at making things, which does not necessary imply a movement preference for learning. By contrast, the visual and auditory scales contain statements that relate directly to learning mode preferences. More work is needed to redesign the kinaesthetic scale in order to replace it. The study therefore shows that such learning style inventories need to be empirically evaluated before dissemination and promotion. This stage of the study also showed that a simple visual versus auditory typology of learning styles does not cover the full variety of preferred learning modes. Some children prefer both visual and auditory modes. By recognizing mixed learning styles, it is possible to go some way to addressing some of the criticisms of learning style overgeneralization, false expectations and labelling (Reynolds, 1997).

The validity of the visual-auditory dimension of learning style using this inventory was evaluated using a quasi-experimental design in teaching word spelling to a group of primary-aged pupils in a classroom setting. The findings showed that word spelling gains were highest when the teaching mode (visual or auditory) matched the learning style preference. This was for gains tested immediately after the teaching and with one week's delay. The study also showed that those preferring both auditory and visual modes showed intermediate gains compared to the visual and auditory groups. This is an interesting finding as it validates the mixed learning style grouping and shows that this group can benefit from either teaching mode, but less so than the single mode groups. The delayed testing also showed that the decrease from the initial gains was least for those taught in their preferred mode.

This small-scale evaluation study of learning styles has some potential weaknesses, and therefore needs to be interpreted with caution. The visual-auditory group was younger than the visual and auditory groups, but had higher pre-test scores. This may mean that the groups being compared were not equivalent. The teaching interventions were also not presented in a different order. Spelling gains might have been different were the teaching interventions presented in a different sequence. Nor did the teaching evaluation involve the 'blind' teaching of the different learning styles groups. It could be argued that the teacher who taught by the two methods knew pupils' learning group membership and this could have affected the quality of teaching to different pupils. This possibly threatens the validity of the experimental teaching, but it is unlikely as the teaching was not done on an individual basis, but with the whole group.

The study also focused on evaluating differential impact for those with high levels of learning style, not those with medium levels on the scale. It might be that learning styles is not relevant to those learners with low to medium style levels.

Nevertheless, the study makes a contribution by illustrating differential learning outcomes over a short period for different teaching methods in a school setting, as few other studies have done. It is consistent with a refined version of current moves to apply learning style to teaching. The findings are relevant, comprising an addition to the differential learning advocated by Riding and Rayner (1998). They have relevance, too, for current teaching policy and practice, indicating how a practising teacher can organize her classroom to undertake a small-scale, quasi-experimental approach to evaluating teaching; policy-makers attending to the curriculum and teaching who have adopted learning styles and techniques with minimal empirical evidence; and the research community, where there has been much criticism of learning style research (Sternberg & Zhang, 2001).

## Note

1. Children with special educational needs are those in England who have significant learning difficulties and disabilities. They include 3% of all children with more severe and complex needs (who have a statement of special needs), of whom some two-thirds are in mainstream schools, together with 11% with less severe difficulties also in ordinary schools.

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## Appendix 1: Learning style inventory: Each sentence will be read to you. Please tick the yes column if this describes you or tick no if you do not think this describes you.

| Question | Yes | No |
| --- | --- | --- |
| 1. I enjoy lessons when we talk about our work and have discussions with partners or in groups (A) | | |
| 2. I learn things best when I have to get up and do it for myself (K) | | |
| 3. I find it easy to remember things that other people have told me (A) | | |
| 4. I am good at remembering people's faces, even if I haven't seen them for a while (V) | | |
| 5. I am good at making things (K) | | |
| 6. I find it easy to remember stories that have been read to me (A) | | |
| 7. I find it easy to learn new things when they are shown in different coloured writing and with pictures (V) | | |
| 8. I find it easy to remember the words to music (A) | | |
| 9. I like to change what I am doing quite often and have little breaks in between (K) | | |
| 10. When I am trying to spell a word, I find it easy to split the word into different sounds to help me spell it (A) | | |
| 11. When I am trying to remember something like a phone number, I sometimes make up a rhyme or tune to help me remember it (A) | | |
| 12. When I am learning to spell a word, I look closely at the word and try to remember what it looks like in my head (V) | | |
| 13. When I am trying to tell someone what I do, I like to show them by using my hands or body to explain (K) | | |
| 14. I like looking really closely at things and often see things other people have missed (V) | | |
| 15. I remember to spell words by thinking about the pattern made by my hand when writing the letters (K) | | |
| 16. I easily remember information when I see it on a video programme or on the overhead projector (V) | | |
| 17. I find it difficult to sit still for a long time and sometimes fidget (K) | | |
| 18. I can understand things clearly when they are shown in graphs (V) | | |

A = auditory; V = visual; K = kinaesthetic.