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# Computers & Education

journal homepage: [www.elsevier.com/locate/compedu](http://www.elsevier.com/locate/compedu)

## Stop propagating the learning styles myth

Paul A. Kirschner <sup>a, b</sup><sup>a</sup> Open University of the Netherlands, Valkenburgerweg 177, 6419AT Heerlen, The Netherlands<sup>b</sup> University of Oulu, Oulu, Finland

### ARTICLE INFO

#### Article history:

Available online 19 December 2016

### ABSTRACT

We all differ from each other in a multitude of ways, and as such we also prefer many different things whether it is music, food or learning. Because of this, many students, parents, teachers, administrators and even researchers feel that it is intuitively correct to say that since different people prefer to learn visually, audibly, kinesthetically or whatever other way one can think of, we should also tailor teaching, learning situations and learning materials to those preferences. Is this a problem? The answer is a resounding: Yes! Broadly speaking, there are a number of major problems with the notion of learning styles. First, there is quite a difference between the way that someone prefers to learn and that which actually leads to effective and efficient learning. Second, a preference for how one studies is not a learning style. Most so-called learning styles are based on types; they classify people into distinct groups. The assumption that people cluster into distinct groups, however, receives very little support from objective studies. Finally, nearly all studies that report evidence for learning styles fail to satisfy just about all of the key criteria for scientific validity. This article delivers an evidence-informed plea to teachers, administrators and researchers to stop propagating the learning styles myth.

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“No amount of belief makes something a fact” – James Randi

“Every man has a right to his own opinion, but no man has a right to be wrong in his facts” – Bernard Baruch<sup>1</sup>

What follows is a combined Invited Comment to this journal and an open letter to all my academic colleagues who are researchers in the field, editors, editorial board members and/or reviewers of scientific journals like this one. In 2013, I published an article in *Educational Psychologist* with my good friend and colleague Jeroen van Merriënboer entitled “Do learners really know best? Urban legends in education”. In this article we discussed a number of urban legends which permeate teaching and education such as learning styles, the digital native, multitasking, the learning pyramid, and so forth. Based upon a Tweet of mine relating to an article in *Computers & Education*, its editors approached me in the following way:

On 18th August, you tweeted the following: “Scientific journal 'Computers & Education' publishes learning styles bull! When will editors stop this absurdity?”. This was related to the recent paper by [Author et al.] on learning styles [URL] in our journal.

We believe that the readers of our journal will be interested in a more detailed scrutiny of learning styles which is why we want to ask you to write an Invited Comment on this topic.

E-mail address: [paul.kirschner@ou.nl](mailto:paul.kirschner@ou.nl).

<sup>1</sup> A variant of this is often attributed to Daniel Patrick Moynahan as “Everyone is entitled to their own opinions, but they are not entitled to their own facts”, but the Baruch reference was made 24 years earlier.

The gist of my criticism of learning styles is that there is no real scientific basis for the proposition (actually it should be relegated to the realm of beliefs) that (1) a learner actually has a certain optimal learning style, (2) (s)he is aware of what that personal learning style is and/or there is a reliable and valid way to determine this style, and (3) optimal learning and instruction entails first determining this learning style and then aligning instruction accordingly.

The assumption that lies at the basis of learning styles is that teachers, trainers, instructional designers, instructional developers, etcetera should take the learning style that (1) learners say that they have or (2) any of a number of specific instruments (e.g., learning styles inventories) determine the learner to have into account when designing, developing, and delivering instruction. If this is done, will it be possible to optimally facilitate learning and allow the learner to fully develop her-/himself and achieve optimal learning outcomes. While this idea seems intuitively appealing and sounds as if it has a certain degree of face validity, there are fundamental difficulties in both diagnosing learning styles and aligning instruction to these styles. In the rest of this Comment I will try to make clear what these problems are.

In our article (Kirschner & van Merriënboer, 2013) we first posited that learning styles poorly classify (actually *pigeon-hole*) learners. Most of the styles that have been 'determined' are based on *types*; the learner is not assigned to a style based on a set of scores on different dimensions, but rather is classified into a specific – often exclusive – group (see Cassidy, 2004; Coffield, Moseley, Hall, & Ecclestone, 2004 for an overview of learning styles). The first problem here is that people cannot simply be clustered into specific and distinct groups as is shown in a number of studies (see, for example Druckman & Porter, 1991). Most differences between people on whatever dimension one might think up are gradual and not nominal. Even the classification sex/gender which has, until recently, been considered dichotomous has been shown to be quite more nuanced than that. Proponents of using learning styles tend to disregard this and use arbitrary criteria such as a median or a mean on a certain scale to assign a person to a specific style.

With respect to this simple pigeon-holing of learners, Barbara Prashnig (2005) who could be considered to be a proponent of learning styles and who is a developer of learning styles instruments, writes that in one of the most complex and detailed learning styles instruments on the market [the Learning Style Analysis (LSA)] there are at least

49 different elements...[with]...intricate style combinations enhanced by degrees of needs ranging from strong preferences to flexibilities to non-preferences. Given those many style components...it is not possible to label learners by just selecting one style feature as the predominant one. (p. 2)

As to the number of pigeon-holes that have been created, Coffield et al. (2004) write that “the sheer number of dichotomies in the literature conveys something of the current conceptual confusion” (p. 136). In their review, they refer to 30 different dichotomous learning styles in the literature<sup>2</sup> (see Table 1).

The second problem has to do with the validity, reliability and predictive powers of the learning styles tests being used. Stahl (1999) reported inconsistencies and low reliabilities for the measurement of learning styles; when individuals complete a particular measurement at two different points in time. In other words, the test-retest reliability is quite low. This is also related to the information often used to assess learning styles. The most often used method is self-report. Unfortunately, the adequacy of self-report for assessing a learning style is highly dubious (see, for example, Veenman, Prins, & Verheij, 2003). The reason for this is that learners are either not able and/or not willing to truthfully report what they do or what they think that they do. To illustrate the unreliability of self-report, Rawson, Stahovich, and Mayer (2016) asked students when they did their homework and how long they worked on it. They also gave these students a 'smartpen' which noted when and how long they worked on their homework. While there was a significant positive correlation between the amount of time students spent on their homework and the students' course grade as measured by the smartpen ( $r = 0.44$ ), there was no significant correlation between the course grade and time spent on homework as reported by the students ( $r = -0.16$ ). In other words, there was no real correlation between subjective self-report and objective measurement. Also, nearly all students greatly over-reported their homework time (88% of the students). Finally, Massa and Mayer (2006) found that when students reported their preference for verbal information as opposed to visual information, this preference was only weakly related to their actual abilities when they were objectively measured (i.e., their spatial ability).

Also, the self-reported preferred way of learning is often a bad predictor of the way people learn most effectively; what people prefer is not, per definition, what is best for them. Knoll, Otani, Skeel and Van Horn (2016) conclude learning styles are associated with subjective aspects of learning but not objective aspects of learning. In other words, the question arises as to whether learners actually “know” what is best for them. Clark (1982) published a watershed meta-analysis with respect to learner preference for choosing a certain type of instruction and found that the reported preference was most often – at best – not correlated to what and how much was learnt or was actually negatively correlated. In other words, those learners who said that they preferred a particular way of learning typically did not learn better or actually even performed worse when it was used. He termed the latter *mathemathantic*<sup>3</sup> (from the Greek roots *mathema* = a study where something is learned + *thanatos* = death); that is, an instructional method that on the one hand matches the way that the learner say to

<sup>2</sup> If there are 'only' 30 dichotomous variables which can apply to learners, then there are  $2^{30}$  (2 to the 30<sup>th</sup> power) different combinations of these 30 dichotomous styles which means that there are at least 1,073, 741, 824 different learning styles. If we only count children here (estimated at 2 billion), this means one style for every two children.

<sup>3</sup> Ernst Rothkopf had earlier (1970) (Rothkopf, 1970), coined the term *mathemagenic activities* (*gigneshai* = to be born) which he defined as those learning activities which cause or give birth to learning.

**Table 1**

30 Learning Styles discussed in Coffield et al. (2004).

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

prefer for learning but which is unproductive or harmful to her/his learning (Clark, 1989). In such situations, a compensatory or even a remedial model of instruction (see Salomon, 1971 as well as Berliner & Cahen, 1973 when they discuss Trait-Treatment Interactions) is probably a better approach as it 'prescribes' an approach that can compensate for the unwanted effects of a particular disposition or preference (van Merriënboer, 1990). To put it in a different context, while most people prefer sweet, salty, and/or fatty foods, I think we can all agree that this is not the most effective diet to follow, except if the goal is to become unhealthy and overweight.

With respect to the reliability and validity of determining a person's learning style, Coffield et al. (2004) reviewed the 13 most often used instruments for determining learning styles with respect to minimal psychometric criteria, namely internal consistency, test-retest reliability, construct validity, and predictive validity (see Table 2; in their report Table 44).

**Table 2**

Thirteen learning styles models/instruments matched against minimal criteria. (Coffield et al., 2004; the references to the instruments can be found in this report).

Table 4 4 13 learning-styles models matched against minimal criteria		Internal consistency	Test-retest reliability	Construct validity	Predictive validity
✓ criterion met	1 Jackson	—	—	—	—
×	2 Riding	×	×	×	×
×	3 Sternberg	×	×	×	×
—	4 Dunn and Dunn	×	×	×	✓
no evidence either way or issue still to be settled	5 Gregorc	×	×	×	✓
Note	6 Honey and Mumford	×	✓	×	×
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.	7 Kolb	—	✓	×	×
	8 Entwistle	✓	—	✓	×
	9 Herrmann	—	✓	✓	—
	10 Myers-Briggs	✓	✓	×	×
	11 Apter	✓	✓	—	✓
	12 Vermunt	✓	✓	✓	×
	13 Allinson and Hayes	✓	✓	✓	✓

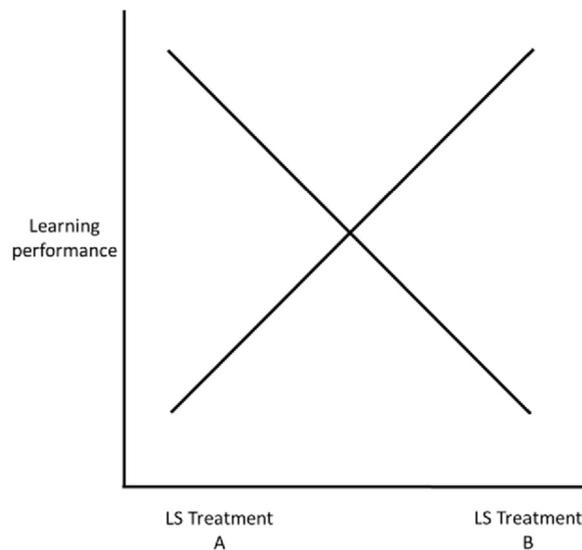


Fig. 1. Crossover interaction.

They conclude that three of the models did not meet any of the four criteria (Jackson; Riding; Sternberg's multiple intelligences), four met only one criterion (Dunn & Dunn; Gregorc; Honey & Mumford; Kolb), three met two criteria (Entwistle; Herrmann; Myers-Briggs personality type indicator), two met three criteria (Apter, Vermunt) and only one met all four criteria (Allinson & Hayes cognitive style indicator), but this instrument measured cognitive styles and not learning styles.

We concluded in our (Kirschner & van Merriënboer, 2013) article,

When designing instruction that takes differences between learners into account, one should assess cognitive abilities rather than preferred learning styles because abilities are better predictors of how people learn most effectively. Moreover, these cognitive abilities should be objectively measured on an ordinal scale and in an objective way, rather than by subjective self-reports that are used to assign people to types on the basis of one or more arbitrary criteria. (p. 6)

As a thought experiment, let's disregard all of the difficulties just discussed in relation to measuring and determining learning styles, and then ask *how* should we tailor instruction to the preferred or determined learning styles. Here, the *learning-styles hypothesis* (Pashler, McDaniel, Rohrer, & Bjork, 2009) is important, namely that a *crossover interaction* (see Fig. 1) will be found in which a specific type of learner learns significantly better with an instructional method tailored to her/his learning style, whereas a different specific type of learner (i.e., a learner with an opposing learning style) learns better with an instructional method tailored to her/him.

For example, according to this hypothesis, verbal learners will learn best when they are taught through verbal instructional methods (e.g., when they are given a book or an article to read), but perform miserably when given a video to watch. In contrast, visual learners will learn best when they are taught through visual instructional methods (e.g., when they are asked to watch a video), but perform miserably when given a book to read. Important here is that it is not sufficient that a statistically significant interaction is found between a certain style and a certain method. Only real crossover interactions can be used to confirm the learning-styles hypothesis.

Taking this all into account, the question arises whether there are sufficient studies reporting robust crossover interactions between style and method, regardless of whether a preferential, remedial, or compensatory model forms the basis for the interactions. Unfortunately for the adherents of learning styles, this is not the case (see Coffield et al., 2004; Pashler et al., 2009; Rohrer & Pashler, 2012). Pashler et al. (2009, p. 105) conclude that "at present, there is no adequate evidence base to justify incorporating learning-styles assessments into general educational practice. Thus, limited education resources would better be devoted to adopting other educational practices that have a strong evidence base, of which there are an increasing number".

In contrast, a number of well-designed recent studies contradict the learning-styles hypothesis. Pashler et al. (2009) stated that good research investigating learning styles should take three steps into account:

1. Start by *examining the purported learning style* of the respondents in the study Rogowsky, Calhoun, and Tallal (2015), for example, examined visual versus auditory learning styles.

2. Participants must then be *randomly allocated to groups* with half receiving instruction specifically matching their learning style and the other half instruction matching the opposite style (e.g., visual learners in one group are required to read, while visual learners in the control group are required to listen).
3. All participants need to take the *exact same test*.

When taking these three steps into account, [Constantidinou and Baker \(2002\)](#), for example, found no relation between having a purported visual learning style and the learning of verbal items either presented in a visual or an auditory way. [Massa and Mayer \(2006\)](#) also found nothing to support the idea that different instructional methods, emphasising either pictorial or verbal information, were of benefit – in a crossover manner – to visualizers and verbalizers respectively. Similar negative results have been found for other learning styles. In medical education, [Cook, Thompson, Thomas, and Thomas \(2009\)](#) found no support the premise for working either from problems to theory (i.e., using an inductive leaning approach) or from theory to problems (i.e., using a deductive learning approach), would lead to better learning for sensing/concrete learners and intuitive/abstract learners respectively. Finally, [Rogowsky, Calhoun, and Tallal \(2015\)](#) found no statistically significant relationship between the preference for a particular learning style (i.e., auditory, visual word) and learning (i.e., listening comprehension, reading comprehension).

And the list of research showing that the learning styles emperor has no clothing is exhausting. What follows are two interesting quotes from the large corpus of learning styles research:

From [Morrison, Ross, Kalman, and Kemp \(2011, p. 59\)](#) “Despite the extensive literature on learning styles, questions remain regarding the degree to which such styles can be matched to teaching methods with any benefits to learning ([Knight, Halpin, & Halpin, 1992](#); [Park & Lee, 2004](#); [Snow, 1992](#)).”

From [Dembo and Howard \(2007, p. 107\)](#) “... learning style instruments have not been shown to be valid and reliable, there is no benefit to matching instruction to preferred learning style, and there is no evidence that understanding one's learning style improves learning and its related outcomes... We urge instructors to reconsider their instructional practices, especially the advice they give students about learning styles, and base their practices on sound research.”

To finish, what follows is four conclusions that can be made with respect to learning styles and learning styles research:

1. The premise that there are learners with different learning styles and that they should receive instruction using different instructional methods that match those styles is not a ‘proven’ fact, but rather a belief which is backed up by precious little, if any, scientific evidence.
2. There are a lot of very fundamental problems regarding measuring learning styles.
3. The theoretical basis for the assumed interactions between learning styles and instructional methods is very thin.
4. Significant empirical evidence for the learning-styles hypothesis is almost non-existent.

On another note, [Coffield et al. \(2004\)](#) state that the concept of learning styles is so ill defined that it is effectively useless for instruction. [Wheeler \(2011\)](#) summed this up as follows, “Probably the only reason some teachers (and many training organisations) hang on to the idea of testing learning styles is that it is convenient to do so, and that to ditch the idea altogether would leave them having to work harder with students.”

To this I can only add that if and when teachers say that they have proof that using learning styles works, the ‘proof’ that they give is primarily anecdotal. According to [Rosenthal and Jacobson \(1992\)](#) what they see and/or experience, is most probably because when teachers expect enhanced performance from their students, the performance is enhanced. This is known as the *Pygmalion* or the *Rosenthal effect* where higher expectations lead to an increase in performance. Rosenthal argues that such biased expectancies affect reality and create self-fulfilling prophecies. Related to this, [Reiner and Willingham \(2010\)](#) state:

... learning-styles theory has succeeded in becoming “common knowledge.” Its widespread acceptance serves as an unfortunately compelling reason to believe it. This is accompanied by a well-known cognitive phenomenon called the confirmation bias. When evaluating our own beliefs, we tend to seek out information that confirms our beliefs and ignore contrary information, even when we encounter it repeatedly. When we see someone who professes to be a visual learner excel at geography and an auditory learner excel at music, we do not seek out the information which would disprove our interpretation of these events (can the auditory learner learn geography through hearing it? Can the visual learner become better at music by seeing it?) (np)

[Newton \(2015\)](#) found that the overwhelming majority (89%) of recent research papers – with the date range July 23, 2013 to July 23, 2015 – listed in the ERIC and PubMed research databases, implicitly or directly endorsing the use of learning styles in higher education. We want to urge ourselves as scientists to get our act together. [Howard-Jones \(2014\)](#), reporting on a study he conducted with [Dekker, Lee, Howard-Jones, & Jolles 2012](#) found that 95% of teachers in Great Britain, The Netherlands, Turkey, Greece, and China held the belief that “[I]ndividuals learn better when they receive information in their preferred learning style (for example, visual, auditory or kinaesthetic)”

We are progenitors and gatekeepers of new knowledge. What we study and/or publish can and should make an impact on both the scientific world in which we travel and the world of education which we serve. As such, it is our solemn duty to carry out research and report on good science – independent of positive significant results – and guard against the spreading of

pseudoscience, myths, and outright lies. There is no benefit to be gained by adapting and designing education and instruction to these so-called styles. Actually, in line with the mathemathantic effects of preferred approaches to instruction, it may even be the case that if this is done, administrators, teachers, parents and even learners are negatively influencing the learning process and the products of education and instruction. With this in mind, I feel it necessary – and even our duty – as researchers and/or journal editors and reviewers not to propagate such myths. We must guard our credibility as researchers, as (the mouthpiece of) scientific communities and work to the benefit of those that we serve, namely the scientific community and the population at large, specifically educators and learners.

## Acknowledgement

I am indebted to Jeroen van Merriënboer, with whom I wrote the article which lies at the basis of this piece. I would also like to thank Pedro de Bruyckere, my partner in crime and fellow windmill-fighter against myths and urban legends in education and learning who read and commented on the first version of this piece.

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