

MAPPING THE LEARNING STYLES JUNGLE

Mapping the Learning Styles Jungle
An Overview of the Literature based on Citation Analysis
Ella Desmedt and Martin Valcke
Ghent University

Author Note

Ella Desmedt, Department of Education, Ghent University, Belgium; Martin Valcke, Department of Education, Ghent University, Belgium.

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Correspondence concerning this article should be addressed to Ella Desmedt, Department of Education, Ghent University, H. Dunantlaan 2, 9000 Ghent, Belgium.

Telephone: +32 9 331 29 62. E-mail: Ella.Desmedt@UGent.be

Abstract

Educationists and researchers who consider using learning styles to address individual differences in learning are often daunted by the multitude of definitions, models and instruments. How to choose? There are different reasons why the existing reviews are not sufficiently helpful. In this paper citation analysis is used to build an alternative overview of the learning style and cognitive style literature. The overview outlines the dominant theoretical orientations in the literature, points at their relative impact and shows their interrelationships. As such, the overview can serve as a road-map for those entering the field. Making an informed choice is facilitated.

Since the end of the seventies, learning styles have been embraced by educationists and researchers as a way to address individual differences in learning. Educationists and researchers who consider using learning styles in practice are however often daunted by the multitude of definitions, theoretical models and measuring-instruments. How to find your way in this jungle? How to make a choice? *Learning style* is not a univocal concept. *Cognitive style* is sometimes synonymously used. In the research literature, this conceptual confusion has been criticised by a.o. Adey, Fairbrother, Wiliam, Johnson & Jones (1999), Curry (1983), Grigorenko & Sternberg (1995), Moran (1991), Rayner & Riding (1997), Reynolds (1997), and Riding & Cheema (1991).

From different perspectives, attempts to organise and to reduce this plenty have been presented (a.o. Curry, 1983, 1987, 2000; Grigorenko & Sternberg, 1995; Jonassen & Grabowski, 1993; Miller, 1987; Riding & Cheema, 1991; Rayner & Riding, 1997; Rayner, 2000). But still, for example at the annual ELSIN (European Learning Styles Information Network) conferences, the question for overview and organisation continues to be posed (Cassidy, 2003; Coffield, Modely, Ecclestone & Hall, 2003). The existing reviews do not seem to be sufficiently helpful for educationists and researchers entering the field.

In-depth study and comparison of the reviews revealed some general points of criticism that can account for this limited workability:

1. Inconsistency: When the reviews are brought together the general picture does not become transparent. Intuitively, relations between the reviews' structures can be somehow appreciated, but not unambiguously established.
2. Not exhaustive: The reviews do not represent exhaustive overviews of the available literature of that date. They are selective in the models they include.
3. No clear distinguishing criteria: Inserting not included definitions, models, and instruments in the available overviews seems hard to do. The criteria used to define the distinct categories are often little operational: the reviews usually include only a general description and a few exemplary style models per category.
4. No consideration of differences in scientific impact: While it is well known that some style definitions, models, and instruments have a larger influence in the field than others, the reviews consider them all to articulate the same scientific impact.
5. Bias: Authors look at style research from their own point of view. What Kreuzman (2001) states about the establishment of intellectual traditions in philosophy, can easily be translated to the organisation of the learning style literature:

. . . it is usually done in a variety of informal ways, for example, by interpreting the writings of the relevant individuals and by looking at the focus and the tone of the work. Although such approaches are useful, they are subject to the biases of the individual doing the classification. The resulting classification may reveal more about the person doing the analysis than the writings being examined. (p. 527)

This explains to a large extent why the categorisations are inconsistent when compared to one another.

6. No context: Only limited information is given about the context of the individual style definitions, models, and instruments included in the reviews. Hardly reference is made to their developers' motivation, theoretical background, and position in the scientific community,... This reflects a conception of science, that considers the development of knowledge as linear and progressive, instead of the result of the work of different researchers, with their own motivations and within their own contexts (Sanders & Van Rappard, 1982).

In this paper, we use citation analysis to develop an alternative organisation of the learning style literature. Using this method we attempt to meet the criticism listed above and

thus try to produce a more workable overview of the field. What are the dominant theoretical orientations in the literature, what is their relative impact and how do they interrelate? Both the literature on learning style and cognitive style is subject of this study. We hope to be able to point out the overlap and differences.

Method

Citation Analysis: a General Introduction

Citation analysis is a quantitative research approach based on the use of the citation indexes. Two measures of scientific activity are used: citation rates of authors, documents, and journals and the number of citation links between authors, documents and journals (Garfield, 1979). In this paper, we will mainly focus on authors.

Citation Rates

The citation rate of a given author equals the number of times individual scholars cite this author in their own work. It is considered as an objective measure for evaluating the research performance of specific individuals or groups.

The validity of this practice is nevertheless heavily criticized by the scientific community (Garfield, 1979; Hauffe, 1994; Kostoff, 1998; MacRoberts & MacRoberts, 1996). A selection of the objections most often raised, is listed in the left column of Table I. They all boil down to the conclusion that the process of citation in itself is not entirely free from subjective, biased practices. Those who advocate the use of citation rates do not deny this criticism. They admit that the use of citation data for evaluation purposes is not simple and stress that these indexes have to be used with care. As Garfield (1983) states: "Citation analysis is not a shortcut to be used as a replacement for thinking" (p. 371). In the right column of Table I a number of methodological and interpretive guide-lines is listed to appraise citation rates in a responsible and fair way (Kostoff, 1998; Garfield, 1979; Phelan, 1999). They will be taken into account to guarantee optimal objectivity of the citation analysis

----- Insert Table I about here

Next to the criticism summarised in Table I, there is also the question whether citation rates inform us about the importance, significance, impact, utility, usefulness, quality, persuasive power, recognition, or influence of a particular author or publication? Moreover, when cognitive and learning style models or instruments are concerned, the question can be raised whether citation data provide information about their psychometric quality. Garfield (1979) is clear about this issue:

The only responsible claim made for citation counts as an aid in evaluating ... is that they provide a measure of the utility or impact of scientific work. They say nothing about the nature of the work, nothing about the reason for its utility or impact. (p. 246)

And, extrapolating this reasoning to our field of interest, the conclusion is that citation rates say nothing about reliability or validity. Although validation studies have indicated that high citation rates correlate with peer judgments of scientific excellence, they cannot be used as a single measure of scientific quality (Garfield, 1979). But they help to introduce an objective element into a more general evaluation process (Phelan, 1999).

For the study of the social sciences and the humanities, as is the case in this paper, Garfield (1979) proposes to use – in addition - the number of documents in which a specific author is cited. Because it is common practice that authors accumulate several citations per article, that measure could give a more accurate indication of the breadth of the impact of their work.

Citation Links

Citation links between authors build on co-citation coupling. The basic assumption of this operation is that if two authors are cited together in a third document, they are considered as related to one another by a shared intellectual focus (Garfield, 1979). Co-citation analysis, the study of these citation links, is a method to define in an objective way the intellectual structure of a scientific field (Small, 1973; Small & Griffith, 1974). The main hypothesis is that science is made up of a structure of specialties that can be uncovered by organising the authors, papers or journals into clusters and by showing the relationships between these clusters (Garfield, 1979). In contrast to the study of citation rates, this study of citation links generates relatively little comment from the scientific community.

Design

Sample

Citation data are the base for this study and build on records from the Institute for Scientific Information's (ISI) Social Science Citation Index (SSCI 1972-present), provided on-line through the Web of Science. The SSCI fully indexes more than 1,725 scholarly journals across 50 social sciences disciplines, and it indexes individually selected, relevant items from over 3,300 of the world's leading scientific and technical journals.

This information was accessed via the Ghent University library website. In September 2001, two general search queries were carried out in this database: learning style in topic, which resulted in 349 records, and cognitive style in topic, with a result of 866 records. "In topic" implies in title, author abstract, or author keyword list. There was no restriction for language or document type.

All the records were saved into two separate files. The combination of these files resulted in a master file that consisted of 1091 records. There was an overlap of 124 records appearing in both files.

Research Questions

Two research questions directed the citation analysis:

1. Citation rates: Who are the most cited first authors in the cognitive and learning style literature since 1972?
This gives information about the relative impact of these authors and consequently also about the impact of the theoretical orientation they belong to.
2. Citation links: Which first authors are cited together in the cognitive and learning style literature since 1972 and on this basis, how does co-citation analysis cluster these authors?

Answering this question will shed light on the intellectual structure of these fields.

What are the dominant theoretical orientations? What are the relations between them?

Data Analysis

The data were analysed using Bibexcel, a tool-box for manipulating bibliographic data, developed by Olle Persson from the Inforsk research group at Umeå University, Sweden (Persson, 2001). It enabled us to import the records from the database queries, select the CR (cited references) field, limit it to cited first authors, count frequencies to compute citation rates, and look for co-occurrences to establish co-citation pairs. This last procedure has a limited processing capacity. That is why only the authors with a citation rate of 10 or higher were included.

The Bibexcel software uses a specific cluster pairs procedure to cluster co-citation pairs. It is a hierarchic clustering routine which the co-citation pairs enter in order of frequency of co-occurrence.

Results and Discussion

To make the results section meaningful for those unfamiliar with the cognitive and learning style literature, the citation-analysis results are accompanied by an interpretation based on a profound study of the content of this literature. For each co-citation cluster, the references of the central and pivotal authors' most cited publication in the cognitive or learning style literature are included. Citation rates of publications were studied to obtain this information.

It is impossible to present the detailed citation-analysis results within the scope of this article. We only give a general overview. The complete lists of citation rates and of authors per cluster can always be obtained from the authors.

Research Question 1

The Most Cited First Authors

The most cited first authors in the cognitive style and the learning style literature are listed in Table II. These authors appear to have had the highest impact on these research fields.

----- Insert Table II about here

The authors are ordered according to citation rates. As Garfield suggested, it is also interesting to look at the number of citing documents to judge more accurately the impact of an author. When two authors have the same citation rate (see for example Riding and Entwistle in the learning style file), the number of citing documents indicates how many different documents account for these citation rates. Therefore, Entwistle's impact on the learning style literature is apparently much broader than Riding's. As the numbers between parentheses Table II show, ordering according to number of citing documents considerably changes the ranking. Only the top authors do not move from their position.

Kolb is the most cited author in the learning style literature. 49% of all documents in the learning style file (349/172) have cited Kolb at least once. Dunn appears as the second influential author. In the cognitive style literature, Witkin has a major impact: 39% of all documents in the cognitive style file (866/340) cite Witkin at least once. He is followed by Kagan and Kirton.

There shows to be little overlap between the cognitive style and learning style lists. Authors much cited in both research areas are Witkin, Riding, Myers, and Eysenck. About Witkin and Riding can be said that these authors developed concepts defined as cognitive style that are especially applied in the context of learning and instruction (as e.g. in Witkin, Moore, Goodenough, & Cox, 1977, and Riding & Sadler-Smith, 1992). This explains their re-appearance as key authors in the learning style literature. Myers' and Eysenck's dual influence is of a different kind. Both authors developed ideas on personality (Myers, 1985; Eysenck, 1964) that apparently inspired the research on cognitive style as well as the research on learning style.

Research Question 2

Theoretical Orientations in the Cognitive and Learning Style Literature

The results of the co-citation analysis shed light on the intellectual structure of the cognitive style and learning style research fields. Prior to answering this second research question in detail, we present a visual representation of the alternative organisation we finally obtained (see Figure 1). This reverse order of presentation facilitates the comprehension of the results below.

----- Insert Figure 1 about here

- The left part of the figure contains the first authors cited by the literature on cognitive style, the right part the first authors cited by the literature on learning style.

- Each quadrangle represents a cluster that resulted from the analyses. The letters A, B,... indicate the order in which the clusters resulted from the clustering procedure.
- The surface of the figures shows the size of the clusters. Between parentheses are the number of authors included.
- The depth of the shades represents the relative impact of a cluster, based on the citation rates of its central authors.
- The ~-sign has to be read as: “Research into cognitive or learning style, in relation to...”.
- The “...” indicate that also other authors are part of the clusters.

The Cognitive Style Literature

Co-citation analysis of the first authors cited by the cognitive style literature since 1972 resulted in 6 main clusters of very different sizes. Only the 337 authors with citation rate of 10 or higher were included in the analysis. 203 of these authors belong to a specific cluster.

Cluster A.

Cluster A is the largest cluster. It centres around Witkin (1971). Other pivotal authors, i.e. authors with a high number of citation links with other authors in the cluster, are Kagan (1964), Myers (1985), Gardner (1953), Messick (1976), Riding (1991), and Kolb (1976). Referring to these authors' citation rates can be concluded that it is a cluster with a very high impact on the field.

According to Witkin et al. (1971), cognitive styles are “... the characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities” (p. 3). They are conceived as manifestations of broad dimensions of personal functioning which cut across diverse psychological areas. Witkin started his laboratory studies into perception in the 1940s. He developed the field-dependence/independence cognitive style construct: in a field-dependent mode of perceiving, perception is strongly dominated by the overall organisation of the surrounding field, in a field-independent mode of perceiving, parts of the field are experienced as discrete from organised ground. It is supposed to be an expression of the extent of differentiation of an individual's psychological structure. The Embedded Figures Test was developed to assess a subject's level of field-independence.

Although most other authors in this cluster developed their own specific style model, the cognitive style research field seems to consider them as being related to Witkin. There is indeed the general link that they all studied consistent individual differences in the perception and processing of information. But this is rather meaningless information.

Possibly, what is seen here is a ceiling effect caused by the fact that 39% of all documents in the cognitive style file have cited Witkin at least once. As a consequence, the event that another author occurs in a reference list together with Witkin is very likely. We expect that this large cluster will break up if Witkin is excluded from the analysis. The result of repeating the co-citation analysis without Witkin confirms this assumption. The authors from Cluster A are spread over four different clusters.

Cluster Aa:

The largest cluster is centred around Kagan (1964). Other pivotal authors are Messick (1976), Goodenough (1976), Pascual Leone (1970), and Oltman (1968). These are all authors with a considerable impact on the field.

In general, this cluster represents a theoretical orientation in which the concept of cognitive styles as consistent, stable, pervasive, personality-related individual differences in organizing and processing information (cf. Witkin's definition), is further examined to look at its implications for cognitive development, memory, and learning. The idea that education should take these differences into account becomes an additional issue.

Kagan (1964) investigated factors that contribute to individual differences in cognitive development in children. Also Pascual Leone (1970) tried to explain cognitive development. Kagan defined the cognitive style dimension of reflection versus impulsivity (“conceptual tempo”) in problem situations where many solution hypotheses are available simultaneously. He measured reflection by response time to first selection on e.g. the Design Recall Test and the Matching Familiar Figures Test.

Goodenough and Oltman were collaborators of Witkin. They investigated the implications of field-dependent/independent cognitive style, especially for learning and memory. They all were affiliated to the Downstate Medical Center of New York State University, and later to the Educational Testing Service. Pascual Leone also used Witkin’s cognitive style as explaining variable in his later work. Messick was vice president for research at the Educational Testing Service when he wrote an overview of the cognitive style research and questioned its implications for education (1976).

Cluster Ab:

In this second cluster, the central author is Myers (1985). Other pivotal authors are Mitroff (1981) and Jung (1921/1971). Psychological type, as developed by Jung, is the central concept in this theoretical orientation. According to Myers’ (1985) operationalisation, it refers to an individual’s preferences on four dimensions: extraversion or introversion, sensing or intuition, thinking or feeling, and judging or perceiving. It affects what is attended to in any given situation and also how conclusions are drawn about what has been perceived. Each pole of a dichotomy is valuable and at times indispensable in its own area of operation. Central instrument here is the Myers-Briggs Type Indicator (MBTI) personality inventory (Myers, 1985).

Cluster Ac:

The third cluster centres on Kolb (1976), but also Riding (1991), Entwistle (1979), and Pask (1972) are pivotal. Except for Riding, these authors are not highly cited in the cognitive style literature. Their impact on the learning style literature is relatively higher.

This probably is because this theoretical orientation focused on pragmatic ways to develop a style concept in educational contexts and to explain differences in real-life learning, out of the laboratory situation. A particular feature is that most of the authors of the review papers discussed in the introduction of this article are also part of this cluster. By writing their overview, they also wanted to enhance application in practice.

Cluster Ad:

The fourth cluster shows Linn (1978) as the central author, together with Strawitz (1984). These authors do not have a great impact on the field, but they do seem to make up a separate research tradition. They study the relationship between Witkin’s field-dependent/independent cognitive style and various formal cognitive abilities in the context of mathematics and science education.

Cluster B.

In cluster B, Kirton (1976) is the central author, and also Goldsmith (1984) and Clapp (1993) are pivotal authors. Kirton’s model of cognitive style is central in the work of these authors. His model distinguishes those with an ability to “do things better” without challenging the structure surrounding a problem (adaptors), from those with an ability to “do things differently” by treating the surrounding structure as part of the problem (innovators). He defined cognitive styles as different, potentially equally valuable, modes of problem perception and problem solving that form a basic dimension of personality. His aim was to allow better mutual appreciation and cooperation between adaptors and innovators in the context of commercial and industrial organisations. The Kirton Adaption-Innovation Inventory (KAI) was developed to locate respondents on this adaptiveness-innovativeness

continuum. Referring to Kirton's high citation rate, this theoretical orientation has a considerable impact.

Cluster C.

Beck (1976) is the central author of Cluster C, and also Abramson (1978), Watson (1984), and Seligman (1979) are pivotal. Its impact on the cognitive style research is rather moderate.

This theoretical orientation's focus is on the relation between cognitive processes and dispositions (like attributions, misconceptions,...), and emotions and behaviour. Beck, Abramson, and Seligman were affiliated to the University of Pennsylvania, where they developed cognitive therapy to treat a.o. depression in a clinical setting. *Cognitive style* is not explicitly used, although reference is made to *attributional style* and to *negative affectivity* as a stable and pervasive trait.

Cluster D.

This cluster centres around Tetlock (1983). Other pivotal authors are Eysenck (1964), Rokeach (1960), and Schroder (1967). This cluster has a moderate impact on the cognitive style field.

What unites these authors is that they all study aspects of personality concerning the openness-rigidity in people's belief system. Tetlock linked these characteristics to political ideology and political decision making. He specifically used Schroder's model of cognitive style, integrative complexity, which refers to individual consistencies in the extent to which categories or dimensions of information are perceived to be interrelated in multiple and different ways (cf. openness).

Cluster E.

The central author in this cluster is Benbasat (1982). Other pivotal authors are Huber (1983), Zmud (1979), and Simon (1977). This theoretical orientation does not have a high impact on the field.

The main research interest of these authors is how designers of decision support systems (DSS) and management information systems (MIS) in the corporate sector should take individual differences in information handling abilities into account. They do not stick to one specific cognitive style model.

Cluster F.

This cluster centres on Bogen (1969) and Kinsbourne (1972). Other pivotal authors are Paivio (1971) and Galin (1972). None of these authors are highly cited, so it seems to be a theoretical orientation with a relatively low impact on the cognitive style literature. It mainly concerns research in neurology to establish the idea that the brain consists of two entities (right-left brain) with different characteristics and different functions. Without explicitly defining the concept, cognitive style here refers to the part of the brain that is most dominant.

The Learning Style Literature

Co-citation analysis of the first authors cited by the learning style literature since 1972 resulted in two main clusters. Only the 95 first authors with a citation rate of 10 or higher were included in the analysis. 67 of these authors belong to a cluster.

A first observation, after examining the affiliations of the authors, is that the authors in Cluster A are for the most part working in the US, whereas the authors included in Cluster B

seem to form a distinct British-European (and Hong Kong) theoretical orientation in learning style research.

Cluster A.

Cluster A is the largest cluster. It centres around Kolb (1976). Other pivotal authors are Dunn (1978), Honey (1982), and Plovnick (1975). It includes the two most highly cited authors in the learning style literature and thus has a very high impact on the learning style research field.

Within an experiential learning framework, Kolb (1984) defined learning styles as distinctive individual differences in the learning process that arise from consistent patterns of transaction between the individual and his or her environment. Through their past and present experiences, individuals program themselves to grasp reality through a particular degree of emphasis on the four modes of the learning process: concrete experience, reflective observation, abstract conceptualization, and active experimentation. The Learning Style Inventory (1976) was created to assess these orientations towards learning.

Because we know that 49% of all documents in the learning style file cite Kolb at least once, a ceiling effect might also here explain the broad nature of this cluster. The result of repeating the co-citation analysis without Kolb confirms this assumption. The authors from Cluster A are spread over two different clusters.

Cluster Aa:

In the first cluster, Dunn (1978) is the central author. Also Myers (1980), Witkin (1977), and Curry (1987) are pivotal authors.

This cluster groups a variety of learning style models. However, together these authors form the theoretical orientation that is at the heart of learning styles research. They all agree that learning styles are consistent individual differences in the way people learn, that there is no “good” or “bad” learning style, and that it is very important that education meets their specific strengths and weaknesses.

Dunn’s Learning Style Inventory (LSI, Dunn, Dunn & Price, 1975) was the first instrument to assess an individual’s learning style in grades 3 through 12. It summarizes the environmental, emotional, sociological, and physical preferences a student has for learning. It explicitly does not measure underlying psychological factors.

It is interesting to see that Witkin and Myers, who are pivotal authors in the cognitive style literature, are also central authors in this theoretical orientation. But the publications with which they have had the highest impact on the learning style literature are of a different kind: instead of defining a cognitive style model, they explicitly explain how this model can be applied in educational practice.

Cluster Ab:

In the second cluster Freedman (1980) is the central author. Other pivotal authors are Sims (1986) and Merritt (1984). These authors all had a considerable impact on the learning style research field. They make up a theoretical orientation that critically examines the usefulness and properties of Kolb’s learning style model, mainly in the context of business and business education. Their focus is on the (weak) measurement properties of the Learning Style Inventory.

Cluster B.

Entwistle (1983) is the central author in Cluster B. Other pivotal authors are Marton (1976) and Biggs (1993). They make up the phenomenographic tradition (Marton, 1981) in the research into individual differences in learning. It is a distinct theoretical orientation with a considerable impact on the learning style research field.

These authors want to understand the experience of learning from the student’s perspective, in naturalistic settings in higher education. Data are collected through interviews

and self-reports. They use the concept of *approaches to learning* to point at individual differences instead of learning styles.

The main idea is the distinction between a deep approach to learning, through which the student seeks personal understanding, and a surface approach where the student simply tries to reproduce the information presented during a course (Marton et al., 1997). These approaches comprise both motive and strategy components and are only meaningful in context. They are related to student intentions and to the teaching/learning context on the one hand, and to the quality of the learning outcome on the other. Therefore, they are less static than learning styles or cognitive styles (Biggs, 1993).

The Approaches to Studying Inventory (ASI) was developed to assess these approaches to learning (Entwistle & Ramsden, 1983).

Analysis of the Master File

Co-citation analysis of the master file of cognitive style and learning style literature generated a remarkable result.

The cognitive style Clusters B, C, D, E, and F reappear in a comparable fashion. However, the largest cluster resulting from this analysis incorporates the original cognitive style Cluster A and also all learning style clusters. This should not surprise, because Witkin is very highly cited in the learning style literature and the core authors of the learning style clusters (Kolb and Entwistle) were represented in cognitive style Cluster Ac.

Conclusions

Citation analysis was used to produce an alternative overview of the cognitive style and learning style literature. Nine theoretical orientations could be distinguished in the literature on cognitive style. Four of them showed to be strongly related to the founding work of Witkin, who is the authors with the highest impact on the cognitive style research field. In the learning style literature, three distinct theoretical orientations were identified. Two of them form the American tradition in learning styles research and are related to the work of Kolb, the author with the strongest impact on the learning style literature. They are at the core of the learning styles research field. The third, British-European orientation, rather focuses on phenomenographic research into approaches to learning.

The alternative overview also aids in solving the conceptual confusion between *learning style* and *cognitive style*. When the theoretical orientations studying these concepts are compared, some differences become clear.

Most cognitive style models are developed in laboratory or clinical settings to explain individual differences in cognitive processing. They are applied in various fields. The recurrent features of the concept seem to be stability, pervasiveness, bipolarity and a strong interdependence with personality. The learning style models are developed and used in various educational contexts to explain and accommodate individual differences in learning. Learning styles are generally defined as relatively stable and consistent. It is however acknowledged that the characteristics of the learning environment and learning experiences influence their development.

The overlap between both research fields also becomes apparent. There is a strong relationship between them: the citation analysis showed that Witkin's work is fundamental for both. The conceptual confusion probably arises from the work of the authors who investigate the application of cognitive styles in an educational context: Witkin, Riding, Myers,... The alternative overview enables us to point at the theoretical orientations in which there is a high chance that both concepts are interchangeably used: Cluster Ac in the cognitive style

literature, and Cluster Aa in the learning style literature. Cognitive styles applied in education become learning styles...

Does this alternative organisation meet the criticism formulated of the existing reviews?

1. **Inconsistency:** Because this alternative organisation on its turn was constructed from a completely different point of view, reaching a high level of consistency with the existing reviews was not a central aim. Off course, relations can be somehow appreciated, but again not unambiguously established.
A surplus value of this overview however is that it also situates the existing reviews within a particular theoretical orientation. This shows that the existing reviews are in fact very consistent. At the level of the context of discovery, they all had the same goal: enhancing application of cognitive and learning styles in practice.
2. **Not exhaustive:** All the cognitive and learning style literature retrieved from the SSCI database was included in the analysis. However, the database search and the database itself had some limitations. Learning style and cognitive style were used as search terms. Using learning styles and cognitive styles in addition would have generated a more full picture. It might also be that there are publications on learning style or cognitive style that do not have these terms in their title, abstract, or keywords. But how can they be found? A next thing is that the SSCI only indexes scholarly journals, from 1972 on. Monographs, book chapters, more popular literature, commercial publications, research reports, and older literature are not included. For the SSCI is the only database that includes cited references, there was no other option. So when reference was made in this article to “the” cognitive style literature, or “the” learning style literature, it implied these limitations.
Further, during the analysis procedure, certain authors did not meet the minimum criterion of a citation rate of 10 or higher. This resulted in a drop out of authors with little or no impact on their research field. There were also authors who did not belong to a particular cluster. They also disappeared from view. And then lastly, in the results and discussion section, we did not give a full list of authors per theoretical orientation. The full analyses results can however be obtained from the authors.
So, presenting this alternative organisation as an exhaustive overview would be immoderate. But because it was our explicit attempt to be exhaustive, the final result has become more complete than the existing reviews.
3. **No clear distinguishing criteria:** Being co-cited was the criterion to link authors with each other. The different theoretical orientations could be identified on the basis of these links. The distinguishing criteria are therefore clear and operational. Allocating not included definitions, models, and instruments can be done by checking which authors, from which theoretical orientation(s), appear in their references.
4. **No consideration of differences in scientific impact:** Citation rates were used, so the specific scientific impact of the authors is a central issue in the alternative organisation.
5. **Bias:** Citation analysis is an objective way to organise the literature. Neither at the level of the initial selection of the literature to be organised, nor at the level of inclusions/exclusion in clusters, did the researchers influence the process. Only in the discussion of the cluster structures, is it possible that our assumptions might have been in play. Due to the transparency of the research procedure, these assumptions can be easily tested by others. Off course, more fundamentally, using citation analysis as a method is also a biased choice. It implies to affiliate with the logic and presuppositions of this quantitative method. This method was however fully explained, it is up to the reader to judge its validity.

6. No context: Citation analysis generated an organisation that reflects the broader context of the various cognitive and learning style definitions, models, and instruments. The clusters demonstrate how the *contexts of discovery* (Sanders & Van Rappard, 1982) of the cognitive style research and the learning style research differ from, and relate to, each other.

Further refinement of the citation-analysis technique is however needed. We have to stress the fact that only basic bibliometric techniques have been used. A possible improvement would be the incorporation of the impact scores of the journals in which the authors publish. Also more sophisticated multidimensional scaling techniques could be used to perform co-citation analysis.

Despite all its weaknesses, and despite the fact that it might not give a lot of new information for those familiar with the literature, this alternative organisation will be very helpful for educationists and researchers entering the learning styles field. It can serve as a road-map by giving an overview of the dominant theoretical orientations and pointing at their interrelationships. By simply pointing at fundamental previous research, and by showing that a choice for a certain model implies using *cognitive style* or *learning style* in a specific sense, originating from a specific theoretical orientation, this overview enables future researchers to make an informed choice when they consider using learning styles in practice.

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Table I
Citation Rates: Objections and Methodological and Interpretive Guide-Lines

Objections	Methodological and interpretive guidelines
A paper, author, or journal might be cited frequently in refutation or as a negative example.	Scientists tend to ignore inferior work that is of little importance. Work being criticized, is mostly of some importance.
A citation rate can be inflated by self-citations.	Studies show that up to 10% of all citations are self-citations. It is a common and accepted practice. If authors try to use self-citation to inflate a rate, this will be very obvious and easily detected.
A prestigious journal might draw more citations than a less prestigious one.	First, the impact factor from <i>ISI Journal Citation Reports</i> can be used to take into account this “prestige” factor. Second, studies show that the effect of journal prestige on citation counts may not be overestimated.

Objections	Methodological and interpretive guidelines
Methodological contributions tend to be cited more frequently than theoretical publications.	This is an objection especially raised by scientists who feel that methodological advances are less important than theoretical ones. The validity of this statement can be questioned. Second, studies show that methodological papers do not inevitably draw a large number of citations.
Citations also serve political, financial, and ego-satisfaction purposes.	Aggregating citations from different publications cancels out the impact of this type of bias.
Cronyism: researchers especially cite their colleagues.	It is true that there are groups of researchers who tend to cite each other. But, if the groups consist of highly cited individual authors, they can be considered as “gatekeepers” that form an invisible “college” in a particular field or area. Cronyism is then little more than a manifestation of the power relations within the scientific field.

Objections	Methodological and interpretive guidelines
Obliteration: not all authors cite the obvious, classical antecedents.	This phenomenon is usually observed in the work of scientists whose work has become part of the main body of knowledge. However, before this takes place, the citation count and the reputation of these scientists usually reach a level that makes additional citation credits less necessary. To take this criticism into account, evaluation of citation rates should always be made by people acquainted with the field of study.

Table II
Most Cited First Authors of the Cognitive and Learning Style Literature

Cognitive style			Learning style		
Author	Cit. rate	No. cit. docs.	Author	Cit. rate	No. cit. docs.
Witkin, H.A.	807	340 (1)	Kolb, D.A.	341	172 (1)
Kagan, J.	254	128 (2)	Dunn, R.	195	77 (2)
Kirton, M.J.	249	106 (3)	Freedman, R.D.	68	41 (4)
Riding, R.J.	246	57 (7)	Schmeck, R.R.	65	40 (5,5)
Tetlock, P.E.	224	37 (19,5)	Riding, R.J.	62	18 (27,75)
Beck, A.T.	110	45 (11)	Entwistle, N.J.	62	47 (3)
Messick, S.	94	82 (4)	Witkin, H.A.	57	40 (5,5)
Pascual Leone, J.	93	28 (33)	Sims, R.R.	45	32 (8)
Goldsmith, R.E.	84	31 (24)	Keefe, J.W.	45	37 (7)
Suedfeld, P.	81	18 (63)	Biggs, J.B.	44	31 (9)
Foxall, G.R.	77	20 (53,5)	Gregorc, A.F.	42	22 (20)
Goodenough, D.R.	77	60 (6)	Marton, F.	41	28 (11,5)
Oltman, P.K.	75	64 (5)	Curry, L.	39	29 (10)
Kogan, N.	70	53 (9,5)	Furnham, A.	39	14 (38)
Myers, I.B.	69	54 (8)	Carbo, M.	38	13 (43)
Eysenck, H.J.	66	42 (13)	Laschinger, H.K.	36	13 (43)
Piaget, J.	60	43 (12)	Myers, I.B.	35	28 (12)

Simonton, D.K.	60	6 (439)	Price, G.E.	35	27 (13,5))
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Cognitive style

Learning style

Author	Cit. rate	No. cit. docs.	Author	Cit. rate	No. cit. docs.
Messer, S.B.	56	53 (9,5)	Atkinson, G.	34	23 (17,5)
Gardner, R.W.	55	38 (17)	Eysenck, H.J.	33	12 (49,5)
Rokeach, M.	55	32 (22)	Merritt, S.L.	33	27 (13,5)
Saracho, O.N.	54	21 (49)	Vermunt, J.D.	33	18 (27,75)
Cronbach, L.J.	50	40 (15)	Katz, N.	30	22 (20)
...			Veres, J.G.	28	26 (15)
			Johnson, D.W.	28	11 (54)
			Honey, P.	27	25 (16)
			Cornwell, J.M.	26	19 (24)
			Pask, G.	26	23 (17,5)
			...		

Note. Only the authors with the twenty highest citation rates are included. Between parentheses, their rank number based on the number of citing documents is added. Cit. rate = citation rate; no. cit. docs. = number of citing documents.

Figure Captions

Figure 1. Visual representation of the alternative organisation.

