

INSIGHT INTO THE BIBLIOMETRIC DATA: AN ANALYSIS OF THE CORRELATION OF DOMINATING LEARNING TYPES AND THINKING STYLES

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ABSTRACT

This paper is aimed to provide a clear insight into the use of bibliometric data as a meaningful tool to analyze thinking and learning styles as well as their correlations to understand a constructive web-based learning model. The study employed a quantitative analysis through a cross-tabulation calculation with contingency coefficient-test statistical approaches using participants of 524 undergraduate students. Furthermore, bibliometric analysis was carried out using 228 research articles that were obtained from the Scopus database from 2004 to 2021. Results exhibited there were two dominating approaches in learning types, namely collaborative type and competitive type, in which the collaborative type might represent a more strongly high-weighted category as compared with the competitive one. On the other hand, the executive style had been found as the most dominating thinking style relative to the global style. It is worth noting that this study also indicated the most influential authors, journals, institutions, and countries about the research field of learning and thinking models, along with some possible research directions in the future.

Keywords: Bibliometric Analysis, Thinking Style, Learning Style, Psychology, Education

INTRODUCTION

The study of learning types and thinking styles is mainly derived from the other studies relating to psychological and social aspects as well as physiological instructions (Boroujerdi & Hasani, 2014). There is always a great interest in examining in-depth descriptions of thinking and learning styles within the educational model as well as their correlation factors. Learning styles can be related to learning behaviours (Clariana & Smith, 1988) and learning effectiveness (Mehlenbacher et al., 2000; Whittaker & Ackerman, 2002; Simon, 2000) in educational practices. An issue in learning styles emerges recently due to a learning process through a model which so-called Web-based Learning, whereas this kind of learning style can greatly give a positive impact on both effectiveness and efficacy in the current learning models. In meantime, thinking style is an important psychological faculty as it comes out from the social and emotional backgrounds of an individual's intelligence (Sun et al., 2005).

Currently, cognitive and learning style differences have become one of the interesting learning topics to be discussed by many educational researchers and practitioners. Snow et al. (1996) explained the constructive cognitive styles and their differences against learning styles. Meanwhile, Sternberg (1997) reported that cognitive style associated with personal characteristics did not directly correlate with the abilities and performances. He even stated that the thinking style is a cognitive style depending on the environment, balance range, broad categories, conceptual style, and impulsive reflective style. Furthermore, some researchers (Curry, 1983; Riding & Rayner, 2000; Evans & Sadler Smith, 2006) had reported the meaningful learning models that were devoted to resolve the issue of learning and cognitive differences as well as to imply the improvement of innovative learning styles and continuous studies in educational practices. In addition, many studies in educational thinking styles had also been reported such as Sternberg (1998); Zhang (2004); Cheng (2005); Zhang (2006); Paletz & Peng, (2009); Zhu & Zhang, (2011); Scibinetti et al., (2011); Diliello et al., (2011); Brodin & Frick (2011); Abdi (2012); Yu & Chen, (2012); Chan (2013).

The study presented in this paper is aimed to investigate the thinking and learning styles as well as their correlations to understand a constructive educational web-learning model for undergraduate students. So far, no studies have ever been reported elsewhere regarding the use of bibliometric data to analyze learning and thinking styles. All the data were collected from the Scopus database including the most cited articles, the most eminent authors in the research field of learning and thinking styles, journals, institutions, and countries within the period of 2004-2021. Analyses were then conducted to assess the influential factors and emerging research topics from the perspective of learning and thinking styles to gain a comprehensive understanding of a constructive educational model for academicians and practitioners.

Thinking Style: Definition and Perspectives

Various definitions and perspectives regarding the thinking styles have been reported in many articles. Vance and co-workers (2008) defined a thinking style as one's preferred manner of using mental abilities to guide daily activities, including both understanding and conscious effort to resolve problems and challenges. In other studies, thinking style might be expressed as the preferred or chosen way in using one or more independent abilities to identify thinking styles (Sternberg, 1994; 1997). The thinking style was the preferred choice for solving a problem (Burns & Fedewa, 2005).

Sternberg (1997) argued the thinking style theory that views humans as God's creatures with rights to life and socializes. Therefore, he classified 13 (thirteen) thinking styles based on the five dimensions of functions, shapes, levels, scopes and learning (see Table 1.). The dimension of a function contains three thinking styles, namely legislative, executive, and judicial styles. The form dimension comprises monarchic, hierarchical, oligarchic, and anarchic styles, while the level dimension consists of global and local styles. The scope dimension can be divided into two styles (internal and external styles). In the learning dimension, there are liberal and conservative styles. Additionally, Table 2 tabulates the summary of previous studies on thinking styles.

No	Type of Thinking Style	Definition and Perspective
1	Legislative style	An individual with a legislative thinking style prefers to do things following his way, make rules and resolve problems without the need for structure. He likes a creative atmosphere and the respective fields of work such as creative writers, scientists, architects and policymakers.
2	Executive style	The executive style is the tendency to think that someone intends to follow rules which are constructed. They fill in the gaps between existing structures and newly created structures. They resolve problems in the form of a sequence, adopt the rules, and tend to have high values.
3	Judicial style	The judicial thinking style is a person's tendency prefers to evaluate a situation or circumstance. He often analyzes everything, especially those around the activities such as critical writing, giving opinions on a problem, evaluating the work of others.
4	Monarchical style	Someone tends to complete a job using the available resources and energy. This kind of people often leaves problems unresolved.
5	Hierarchy style	A style of thinking of individuals who like to do a lot of work, but know how to choose the priority, time and energy required. A person with hierarchical thinking knows how to prioritize what needs to be accomplished and accomplished.
6	Oligarchy style	A style of thinking of individuals who can do a lot of work at this point, but don't know how to choose priorities.
7	Anarchy style.	A style of thinking of individuals who like to solve problems randomly and do not like to solve problems with rules, guidelines or systems. Sometimes the approaches used to solve problems can be confusing and difficult to explain.

8	Global style	A style of thinking for individuals who prefer comprehensive, abstract and big picture issues. A person with a global style is more likely to deal
9	Local style	A style of thinking of individuals who like something deeply and specifically and concretely. Local-minded individuals are the opposite of global-minded individuals. They are more inclined towards pragmatic situations.
10	Internal style	A style of thinking individuals who are introverted, task-oriented and like to do their work.
11	External style	A style of thinking individuals who are extroverted, open-minded, like to interact and work with other people.
12	Liberal style	A thinking style of individuals who like to do things in a new way, want to change habits, are open-minded, are not too tied to rules and procedures and like challenges.
13	Conservative style	A style of thinking of individuals who like to follow normal procedures and try to avoid anything less obvious. Those with this style are comfortable with the situation and like something structured.

Table 2
SOME HIGHLIGHTS FROM PREVIOUS STUDIES ABOUT THINKING STYLES

No	Authors/Year	Highlights of the study
1	Paletz & Peng, (2009)	The long-standing notion that dialectical thinking is positively associated with creativity, but suggests the relationship might be culture-, task- and process-specific.
2	Zhu & Zhang, (2011)	the relationship between conceptions of creativity and thinking styles, and bring insights for educators about educational innovations, as one of the key objectives of educational innovations is to develop creativity in the younger generation
3	Scibinetti et al., (2011)	There is no association between motor creativity and motor competence, but there is a significant association between creative moving and thinking for all of their dimensions except for originality
4	Diliello et al., (2011)	Organizational interventions focusing on training supervisors and work-group members to support creativity in the workplace may be more effective than broader and less focused interventions at the organizational level
5	Brodin & Frick, (2011)	Responsible scholars are moved by both critical and creative thinking, which is conceptualized as critical creativity (CC).
6	Abdi (2012)	There was also a positive and meaningful correlation between executive thinking style and the total scores of critical thinking skills.
7	Yu & Chen, (2012)	Thinking styles and preferred teacher interpersonal behaviour among Hong Kong students
8	Chan (2013)	Critical thinking and creativity in nursing: learners' perspectives aimed to reveal nursing learners' perspectives on creativity and critical thinking.

Learning Style: Concept and Definition

Research conducted by Kinshuk & partners, (2009) investigated the dimensions of the learning styles of each individual. It showed that individuals had a preferred learning style and their level of achievement varied according to the learning style adopted. The followings are various concepts and definitions of learning styles taken from various works of literature:

- Learning style describes an individual's preference for understanding their experiences and transforming those experiences into knowledge (Kolb, 1984; Honey & Mumford, 1992).
- A learning style is a strategy used consistently by a person during information processing activities in preparation for testing his memory. It refers to a person's independent learning before they show certain patterns when processing information in tests, completing assignments, and sitting examinations; it thus considers learning styles to be more appropriate for determining an effective learning process (Schmeck, 1983).
- A learning style is a learner's preference concerning their learning process, which includes their information processing behaviour (Cheng et al., 2017).

- Learning styles are defined as "during the interactive impact process of a learner and its learning environment, it will develop a rarely stable response way, which often includes traits of personal knowledge type, physiological habits feeling characteristics" (Keefe, 1988).
- A learning style is an inclination that each of us has to perceive, interpret, and respond to information in a certain way (Whetten & Cameron, 2011).
- A learning style is a method used by a student to understand a subject in the learning process. Learning styles are cognitive, affective, and physiological behaviours that are indicators of how students interact and respond to the learning environment. This definition refers to student behaviour during the learning process (Evans & Sadler-Smith, 2006).
- Learning styles are patterns or learning habits that are commonly carried out by a person (Main, 1980).

Kolb (1979) added that learning styles function as personal means of the processing of information while learning new concepts or principles. He also categorized the learning styles into four levels, namely concrete experience, reflective observation, abstract conceptualization, and active experimentation, respectively. This gives rise to various styles or strategies as individuals process information from stimuli in their respective environments. Thus, the assumptions of different individuals become an important concept for explaining differences in individual styles when information processing from reference materials, completing assignments, solving problems, and answering exam questions.

Dunn et al., (1993) reported in various studies, students exhibited a positive or negative preference for the existing learning style dimension that they chose with the academic affair. In each case, a student would produce better results statistically if the academic matters matched their preferred learning dimension. In this way, students' preferred choice of dimension became their strength in the academic process.

In recent years, studies of the learning style effects on learning effectiveness have been conducted in a variety of domains, including by Nuzhat et al., (2013); McCabe (2014); Alqahtani & Al-Gahtani, (2014); Lee et al., (2016). Moreover, Grasha, (2002) divided student learning styles into six styles, as summarized in Table 3.

No	Type of Style	Definition
1	Competitive learning style	Students learn to resolve problems, and can obtain good achievement as well as attention from lecturers.
2	Collaborative learning style	Students learn together through sharing ideas and abilities.
3	Avoidance learning style	Students are less interested in teaching materials or avoid the class.
4	Participating learning style	Good students intend to attend the lectures and actively participate and explore the lectures' needs.
5	Dependent learning style	Students learn by following their friends' need and lecturers for material and guidance.
6	Independent learning style	Students intending to study alone and believe that what they think is important.

Relationship between Learning and Thinking Styles

An interesting study by Hughes et al., (2000) observed the relationships between learning style and thinking style that had led to academic achievement. Their study used canonical correlations to reveal a moderate relationship between the two types of styles. The research took place at the University of Granada, Spain with a sample of 210 students. They found that those students who tended to work individually were not creative in planning ways to resolve problems. This finding has negative implications to the legislative style of learning, and in meantime emphasizing the rules and procedures associated with the executive learning style will lead to higher academic achievement.

On the other hand, from Kolb's (2015) research on learning styles (LS) and Sternberg's research on thinking styles (TS), a clear correlation was found between the two different types of styles and learning achievement. Regression analysis demonstrated that thinking styles

affected the students' independent learning achievement, which was regarded negative in the legislative category and for high-achieving executive students which were included in the legislative category negative and high achieving executive students. This study suggests that the LS and TS correlations should be re-assessed by including mindset as an important element in the learning processes.

METHODOLOGY

Research Design

The research design used in this study was a quantitative method that employed statistical means to analyze data obtained from the data source. There were the quantitative characteristics adopted such as utilizing direct data sources with the researchers as the main instruments, taking into account the result rather than the process, and deductive. The research design was prioritized into direct data collection, textual details, and the relationship with the psycho-educational perspective. The type of research was a case study and designed according to the obtained data source using a cross-tabulation calculation and bibliometric analysis. Thereby, the use of quantitative research will allow the authors to identify and understand the research findings to construct a web-based learning model according to bibliometric data.

Participants

Participants in this study were undergraduate students from several faculties at the Universitas Medan Area (UMA), Medan, North Sumatera, Indonesia. 524 participants were comprising 246 males and 278 females. In detail, 249 participants came from the faculty of psychology, 126 participants were from the faculty of agriculture, 88 participants were from the faculty of law, and 63 participants were from the faculty of engineering. All participants were given a complete inventory according to Sternberg's thinking styles and Grasha's learning styles.

Data Collection

The main method in the data collection used was observation. This method was used to directly observe learning types and their correlations with thinking styles as a result of the students' understanding of bibliometric data. Learning activities of the students related to Sternberg's thinking styles and Grasha's learning styles were quite difficult to observe directly. Therefore, researchers used a more comprehensive participatory approach using questioners and interviews to indicate the most dominating learning type and thinking style. Data obtained was analyzed using statistical cross-tabulation calculation and bibliometric analysis.

RESULTS

Cross-Tabulation analysis

Using the data taken from all participants, the scores obtained from the standard critical mean were classified to determine the dominating thinking and learning style. The standard critical mean is used according to an assumption that if the score obtained is greater than the critical mean, it is called "dominant"; however, it will be "less dominant" if the score is below or equal to the critical mean value. Table 4 and Table 5 show the standard critical means obtained from categorizing the thinking and learning styles.

Thinking Style	Critical Means
Legislative	4.00
Exsecutive	3.50
Judicial	3.70
Monarchical	3.10
Hierarchy	3.60
Oligarchy	3.10
Anarchy	3.50
Global	3.20
Local	3.10
Internal	3.30
External	4.00
Liberal	4.10
Conservative	3.00

* Type of thinking style is dominant if the mean score obtained > critical mean

Learning style	Critical Mean
Independent	3.90
Avoidance	3.10
Collaborative	3.50
Dependent	4.10
Competitive	3.50
Participative	4.10

* Type of learning style is dominant if the mean score obtained > critical mean

Upon completion of the categorization steps, the Pearson product-moment [correlation] (r) was performed to determine the relationship between learning type and thinking style from each individual (Gravetter, 2012). The preferences of each individual were then concisely described according to the learning types and thinking styles based on high, medium, and low categories, respectively. The values were transformed into visible score Z-score, which was then converted into a T-score, using the formula $z=(x-\text{Mean}) / \text{sd}$ and $T\text{-score}=(10 * z)+\text{sd}$ (Anastasi, 1997). The hypothetical norm was found to determine whether each individual had a high, medium, or low learning type, as shown in Table 6 and Table 7.

Variables	Max Score	Min Score	Range	Mean (μ)	SD (σ)	Low (X ≤ μσ)	Medium (μσ < X ≤ μ+ σ)	High (X > μ + σ)
Thinking style	25	5	20	15	3.3	X ≤ 15	15 < X ≤ 18.3	X > 18.3
Learning style	50	10	40	30	6.7	X ≤ 30	30 < X ≤ 36.7	X > 36.7

Source: Nunnaly (1994)

No	Type of Learning Styles	Total Score	Mean	Critical Means	Remarks
1	Independent	37.06	3.71	3.9	Not Dominant
2	Avoidance	30.92	3.09	3.1	Not Dominant
3	Collaborative	40.98	4.10	3.5	Dominant
4	Dependent	40.42	4.04	4.1	Not Dominant
5	Competitive	37.19	3.72	3.5	Dominant
6	Participative	40.67	4.07	4.1	Not Dominant

Note: Mean = Total score / number of items (10), Dominant if Mean > Critical Mean

From Table 7, it can be pointed out that from the six learning styles i.e. independent, avoidant, collaborative, dependent, competitive, and participative styles, there were two the most dominating learning styles, namely collaborative style and competitive style. From Table 8, it can be concluded that from the thirteen thinking styles, are legislative, executive, judicial, monarchic, hierarchical, oligarchic, anarchic, global, local, external, internal, liberal, and conservative styles, three thinking styles were found less dominant, namely legislative, external, and liberal styles. Meanwhile, the result analysis as can be seen in Table 9 shows that all the dominating thinking styles had a significant correlation with all the dominating learning styles. It had been shown by the fact that the p-value coefficient obtained from each correlation between thinking style and the dominating learning type was lesser whenever the degree of error (α) was close to 1% (0.01).

No	Thinking style type	Total Score	Mean	Critical Means	Remarks
1	Legislative	18.75	3.75	4	Not dominant
2	Executive	21.34	4.27	3.5	Dominant
3	Judicial	19.74	3.95	3.7	Dominant
4	Monarchy	19.24	3.85	3.1	Dominant
5	Hierarchy	20.86	4.17	3.6	Dominant
6	Oligarchy	19.27	3.85	3.1	Dominant
7	Anarchy	19.81	3.96	3.5	Dominant
8	Global	18.76	3.75	3.2	Dominant
9	Local	19.47	3.89	3.1	Dominant
10	External	19.22	3.84	4	Not dominant
11	Internal	20.43	4.09	3.3	Dominant
12	Liberal	20.10	4.02	4.1	Not dominant
13	Conservative	18.72	3.74	3	Dominant

Note: Mean = Total score/total item (5), Dominant if Mean > Critical Means

Thinking style		Learning style	
		Collaborative	Competitive
Executive	Pearson's r	0.69	0.49
	p-value	< .001	< .001
	Sig	S	S
Judicial	Pearson's r	0.64	0.62
	p-value	< .001	< .001
	Sig	S	S
Monarchy	Pearson's r	0.47	0.6
	p-value	< .001	< .001
	Sig	S	S
Hierarchy	Pearson's r	0.64	0.56
	p-value	< .001	< .001
	Sig	S	S
Oligarchy	Pearson's r	0.54	0.52
	p-value	< .001	< .001
	Sig	S	S

Anarchy	Pearson's r	0.62	0.52
	p-value	< .001	< .001
	Sig	S	S
9. Global	Pearson's r	0.51	0.52
	p-value	< .001	< .001
	Sig	S	S
10. Local	Pearson's r	0.59	0.61
	p-value	< .001	< .001
	Sig	S	S
11. Internal	Pearson's r	0.39	0.55
	p-value	< .001	< .001
	Sig	S	S
12. Conservative	Pearson's r	0.46	0.56
	p-value	< .001	< .001
	Sig	S	S
*p=value>0.01, not significant			

Table 9 and Table 10 exhibit that the highest weighted-learning style was the collaborative type which had 427 participants (81.33%), followed by the competitive type with 258 participants (49.14%). In meantime, the executive style was found to have the highest category weight (85.71%) of thinking style, while the global type was indicated as the lowest thinking style (38.10%).

Table 10								
CATEGORICAL DESCRIPTION OF DOMINATING LEARNING AND THINKING STYLES								
Categorizing based on the types of high, medium and low								
Style	Type	Category						
		Low		Medium		High		
		F	%	F	%	F	%	
Learning Style	1	Collaborative	20	3.81	78	14.86	427	81.33
	2	Competitive	81	15.43	186	35.43	258	49.14
Thinking style	1	Executive	10	1.90	65	12.38	450	85.71
	2	Hierarchy	18	3.43	85	16.19	422	80.38
	3	Internal	31	5.90	131	24.95	363	69.14
	4	Anarchy	54	10.29	164	31.24	307	58.48
	5	Judicial	51	9.71	169	32.19	305	58.10
	6	Local	63	12.00	193	36.76	269	51.24
	7	Monarchy	90	17.14	182	34.67	253	48.19
	8	Oligarchy	65	12.38	209	39.81	251	47.81
	9	Conservative	110	20.95	194	36.95	221	42.10
	10	Global	89	16.95	236	44.95	200	38.10

Bibliometric and Citation Analysis

This section elaborates on the analysis of learning type and thinking style relationships using bibliometric data. Firstly, the citation results were analyzed and then followed by in-depth analyses of co-citation and co-occurrence of author keywords. Table 11 shows Syntax search on the Scopus database. In the article citation analysis, all the criteria were reviewed included the number of publications per year, the most cited documents, the most dominating authors, the most dominating journals, the most dominating institutions, and the most dominating countries. As provided in Table 12, there were a total of 228 articles taken from 78 journals, written by

553 authors who were affiliated with 420 institutions from 41 countries along with 9104 references cited totally. This general result provides an overview of all the articles reviewed related to the learning and thinking styles point of view.

Table 11 SYNTAX SEARCH ON SCOPUS DATABASE	
Data Source	Search syntax
Search syntax on Scopus database	TITLE (" LEARNING STYLE" AND "THINKING STYLE ") AND (EXCLUDE (SUBJAREA , "ENGI")) AND (EXCLUDE (SUBJAREA , "BIOC")) AND (EXCLUDE (SUBJAREA , "AGRI")) AND (EXCLUDE (SUBJAREA , "MEDI")) AND (EXCLUDE (SUBJAREA , "PSYC")) AND (EXCLUDE (SUBJAREA , "DECI")) AND (EXCLUDE (SUBJAREA , "EART")) AND (EXCLUDE (SUBJAREA , "COMP")) AND (EXCLUDE (DOCTYPE , "cp"))

Source: Author compilation

Table 12 GENERAL RESULTS	
Summary of General Results	
Criteria	Quantity
Articles	228
Journals	78
Authors	553
Institutions	420
Countries	41
Cited references	9104

Number of Publications per Year

As shown in Figure 1, there were two interesting stages regarding the trend in the improvement of the articles on learning and thinking styles published between 2004 and 2021. The first period took place between 2004 and 2014 could be considered as the most important era of the growing number of studies in learning and thinking styles from the psycho-educational perspectives. During that period, the number of publications reached a maximum value in 2009. The second period was from 2014 to 2021 indicated by the significantly increasing number of publications. It could be observed that the increment was more than twice the first stage values. The highest number of publications was seen in 2020, while the lowest one was in 2016. It could also be seen that the declining trend of the publications that took place in 2021 was implied as to the consequence of the Covid-19 pandemic that delaying further research and publication activities.



**FIGURE 1
NUMBER OF PUBLICATIONS (YEAR)**

The Most Cited Documents

Table 13 shows 23 (twenty-three) the most cited documents in learning and thinking styles which had been cited more than 50 (fifty) times. The documents were ranked in descending order based on the counted citations. It has been observed that 23 articles got at least 50 citations, accounting for 92% of total cited documents or more; and the articles authored by Shiloh, Salton, and Sharabi (2002) was indicated as the most cited document with 130 citations. It is an interesting article as the authors explained the specific combinations of thinking styles, high rational/high intuitive and low rational/low intuitive as the most prone to framing effects. This suggests specificity in the associations of heuristic processing and thinking styles. Pacini & Epstein, (1999) concluded that it would be not possible to make a general statement about a thinking style that was are strongly associated with heuristic processing. The relationships appeared to vary along with the kind of heuristic studied. This was also indicated in the previous studies that the thinking styles related differently with "availability" and "representativeness" heuristics in judgmental tasks than the framing effects on risky choices.

The second most cited article was that authored by Aarnio & Lindeman, (2005). The authors explained that the college students had fewer paranormal beliefs in their study rather than the students from vocational schools, probably due to the stronger preference of college students in analytical thinking. Amongst them, the students studying medicine and psychology had the fewest beliefs, while students in the educational and theological area as the most beliefs. The study duration in education was, however, slightly negatively associated with paranormal beliefs. Intuitive thinking was positively connected with paranormal beliefs. Higher intuitiveness and lower analytical thinking belonged to female students partially explained their higher number of beliefs as compared with the male students. Therefore, it is pointed out that these two articles basically dealt with the learning and thinking style relationships and received a high number of citations eventually.

Rank	Document	Author	Citation
1	Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects	Shiloh S., Salton E., Sharabi D.	130
2	Paranormal beliefs, education, and thinking styles	Aarnio K., Lindeman M.	117
3	Political Extremism Predicts Belief in Conspiracy Theories	van Prooijen J.-W., Krouwel A.P.M., Pollet T.V.	116
4	Cognitive Bias Modification Using Mental Imagery for Depression: Developing a Novel Computerized Intervention to Change Negative Thinking Styles	Lang T.J., Blackwell S.E., Harmer C.J., Davison P., Holmes E.A.	104
5	Individual differences in deductive reasoning	Newstead S.E., Handley S.J., Harley C., Wright H., Farrelly D.	95
6	Everyday Consequences of Analytic Thinking	Pennycook G., Fugelsang J.A., Koehler D.J.	92
7	Morning and evening-types: Exploring their personality styles	Díaz-Morales J.F.	92
8	The Psychological Inventory of Criminal Thinking Styles (PICTS): A review and meta-analysis	Walters G.D.	92
9	An experiential thinking style: Its facets and relations with objective and subjective criterion measures	Norris P., Epstein S.	83
10	Assessing rational and intuitive thinking styles	Witteman C., Van Bercken J.D., Claes L., Godoy A.	81

11	Thinking styles, schizotypal traits and anomalous experiences	Wolfradt U., Oubaid V., Straube E.R., Bischoff N., Mischo J.	73
12	Transgender affirmative cognitive behavioral therapy: Clinical considerations and applications	Austin A., Craig S.L.	65
13	Religiosity, Political Orientation, and Consequentialist Moral Thinking	Piazza J., Sousa P.	65
14	Metacognitive therapy: Cognition applied to regulating cognition	Wells A.	65
15	Tendency to catastrophize somatic sensations: Pain catastrophizing and anxiety sensitivity in predicting headache	Drahovzal D.N., Stewart S.H., Sullivan M.J.L.	61
16	A New Approach to Reducing Disorder and Improving Well-Being	Huppert F.A.	58
17	Metacognitive therapy for PTSD: A core treatment manual	Wells A., Sembi S.	58
18	Assessing thinking styles in the theory of mental self-government: A Hong Kong validity study	Zhang L.-F., Sachs J.	58
19	Measuring proactive and reactive criminal thinking with the PICTS: Correlations with outcome expectancies and hostile attribution biases	Walters G.D.	55
20	Field-dependence/independence: Cognitive style or perceptual ability? - Validating against thinking styles and academic achievement	Zhang L.F.	53
21	Thinking styles and the five-factor model of personality	Zhang L.F., Huang J.	53
22	Relationship between thinking styles inventory and study process questionnaire	Zhang L.F.	53
23	Thinking styles, self-esteem, and socio-economic status	Zhang L.F., Postiglione G.A.	52

The Most dominating Author and Journal

Table 14 and Table 15 show the most dominating authors for the learning and thinking style topics. The authors' influential factors were measured by counting the number of their articles published about learning and thinking styles versus the number of citations from each author which had been counted. It can be that Li-fang Zhang and Li Zhang were the most dominating authors, having 540 and 539 citations, respectively.

Rank	Author	Document	Citation
1	zhang l.f.	18	540
2	zhang l.	2	539
3	sin k.f.	2	448
4	rosário p.	2	412
5	núñez j.c.	2	358
6	muris p.	2	345
7	merckelbach h.	3	325
8	huang j.	2	216
9	gonzález-pienda j.a.	2	181
10	furey j.t.	4	162

Rank	Author	Document	Citation	Average citation per document
1	huang j.	2	216	32
2	zhang l.f.	18	540	28.33
3	rosário p.	2	412	20
4	núñez j.c.	2	358	20
5	gonzález-pianda j.a.	2	181	20
6	de jong p.j.	2	104	19.5
7	merckelbach h.	3	325	17.66
8	muris p.	2	345	17.5
9	zhang l.	2	539	16.5
10	furey j.t.	4	162	11.75

Table 16 shows the most dominating journal that covered the learning and teaching style studies was Personality and Individual Differences, with 55 published articles. The other journal was Frontiers in Psychology, with 17 published articles. For the total number of citations counted, Personality and Individual Differences was found as the most dominating journal with 1300 citations totally, and Assessment with 189 citations. Table 17 lists the average number of citations counted per article, whereas the European Journal of Personality was indicated as the most dominating journal with an averagely of 59.33 citations per article, and Current Directions in Psychological Science with about 46.5 citations per article.

Rank	Journal	Article	Citation
1	Personality and individual differences	55	1300
2	Assessment	8	189
3	European journal of personality	3	178
4	Frontiers in psychology	17	151
5	Behavioural and cognitive psychotherapy	7	145
6	Psychological reports	16	124
7	Journal of interpersonal violence	4	112
8	Current directions in psychological science	2	93
9	British journal of psychology	3	83
10	European journal of psychological assessment	2	81

Rank	Journal	Article	Citation	Average citation per document
1	European journal of personality	3	178	59.33
2	Current directions in psychological science	2	93	46.5
3	European journal of psychological assessment	2	81	40.5
4	Journal of interpersonal violence	4	112	28
5	British journal of psychology	3	83	27.66
6	Personality and individual differences	55	1300	23.63
7	Assessment	8	189	23.62
8	Behavioural and cognitive psychotherapy	7	145	20.71
9	Psicothema	2	40	20
10	Social behavior and personality	3	51	17

The Most Dominating Institution and Country

Table 18 lists the name of institutions worldwide that had produced some documents relating to the studies of learning and thinking styles. The institution name was provided based on the authors, counted citations and their affiliations. So far, it can be seen that the highest number of publications in learning and thinking styles were produced by the University of Hong Kong with a totally of 261 citations. On the other hand, Table 19 shows the most dominating institutions based on average citation per document. As can be observed, Tel Aviv University was the most dominating institution with 130 average citations per document, followed by the University of Hong Kong (52.2 citations per document). Table 20 exhibits the most dominating countries according to highly cited papers related to learning and thinking styles. Based on the total citations counted, the United States is the most dominating country with 1090 citations, followed by the United Kingdom (716 citations).

Rank	Institution	Country	Document	Citation
1	Department of Education, University of Hong Kong, pokfulam road,	Hong Kong	5	261
2	Faculty of Education, the University of Hong Kong, pokfulam road,	Hong Kong	4	116
3	Faculty of Education, University of Hong Kong, pokfulam road,	Hong Kong	4	96
4	The mindtime project llc, ketchum, id,	United States	2	28
5	Faculty of Education, the university of Hong Kong, pokfulam road,	Hong Kong	2	27
6	University of Florida,	United States	2	22
7	The mindtime project llc, p.o. box 4499, ketchum, id 83340,	United States	2	19
8	Walden University, School of Psychology, Minneapolis, mn 55401,	United States	2	19
9	University of Hong Kong,	Hong Kong	2	15
10	Department of Psychology, Tel Aviv University,	Tel Aviv, Israel	1	130

Rank	Institution	Country	Document	Citation	Average citation per document
1	Department of Psychology, Tel Aviv University,	tel aviv, israel	1	130	130
2	Department of Education, University of Hong Kong, pokfulam road,	hong kong,	5	261	52.2
3	Faculty of Education, the University of Hong Kong, pokfulam road,	hong kong,	4	116	29
4	Faculty of Education, University of Hong Kong, pokfulam road,	hong kong,	4	96	24
5	The mindtime project llc, ketchum, id,	united states	2	28	14
6	Faculty of Education, the University of Hong Kong, pokfulam road,	hong kong	2	27	13.5
7	University of Florida,	united states	2	22	11
8	The mindtime project llc, p.o. box 4499, ketchum, id 83340,	united states	2	19	9.5
9	Walden University, School of Psychology, Minneapolis, mn 55401,	united states	2	19	9.5
10	University of hong kong,	hong kong	2	15	7.5

Rank	Country	Document	Citation
1	United States	57	1090
2	United Kingdom	38	716
3	Hong Kong	25	605
4	Canada	13	295
5	Netherlands	9	256
6	Spain	13	252
7	Finland	2	167
8	Israel	3	148
9	Italy	11	135
10	Germany	8	122

However, it is interesting to note that Finland was indicated as the most dominating country in producing documents about the studies of learning and thinking styles, referring to average citation per document (see Table 21). Other dominating countries were Israel, Netherlands, and Hong Kong, with the average citations per document of 49.33, 28.44, and 24.2, respectively.

Rank	Country	Document	Citation	Average citation per document
1	Finland	2	167	83.5
2	Israel	3	148	49.33
3	Netherlands	9	256	28.44
4	Hong Kong	25	605	24.2
5	Canada	13	295	22.69
6	Spain	13	252	19.38
7	United states	57	1090	19.12
8	United kingdom	38	716	18.84
9	Germany	8	122	15.25
10	Italy	11	135	12.27

The Most Frequently Cited Authors

Figure 2 depicts the network of co-cited authors established from the correlations of the number of articles, citations and authors. It demonstrated a clear correlation of citations from 228 articles and 553 authors. The correlation was further narrowed down by including the articles having at least 20 citations, which in resulting 65 articles. Thus, it revealed that Sternberg was the most frequently cited author in learning and thinking styles from 2004 to 2021.

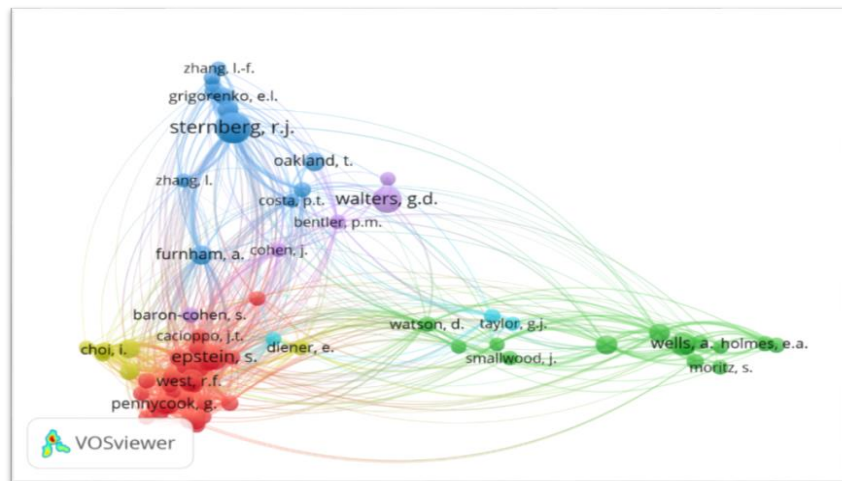


FIGURE 2
NETWORK OF CO-CITED AUTHORS

The Most Frequently Cited Journal

Figure 3 exhibits a network of co-cited journals to determine the most cited journals. This figure depicted the relationships of co-citation and cited journals. Co-citation analysis was conducted to search the most frequently cited journals. It can be seen that the most frequently cited journals were Personality and Individual Differences, Social Psychological and Personality Science, Assessment, Frontiers in Psychology, Psychological Reports, and Behavioral and Cognitive Psychotherapy. The appearance of these journals as the most frequently cited journals implies their important contributions in encouraging the studies in learning and thinking models.

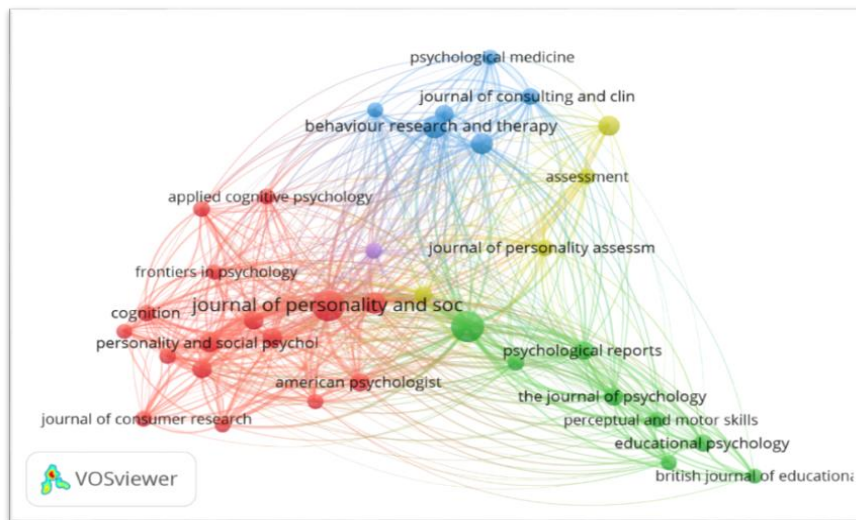


FIGURE 3
NETWORK OF CO-CITED JOURNALS

The Most Frequently Keywords

Figure 4 shows the article keywords concerning the number of publications in learning and thinking styles. It illustrated that the frequently used keywords in the articles related to learning and thinking styles over the past 17 years were "cognition," "psychology evaluation," "criminal thinking," "cognitive reflection," "intuition," "reliability," "religion," and "rumination." This outcome provides valuable information regarding the prominent concepts within the works of literature of learning and thinking styles over the years.

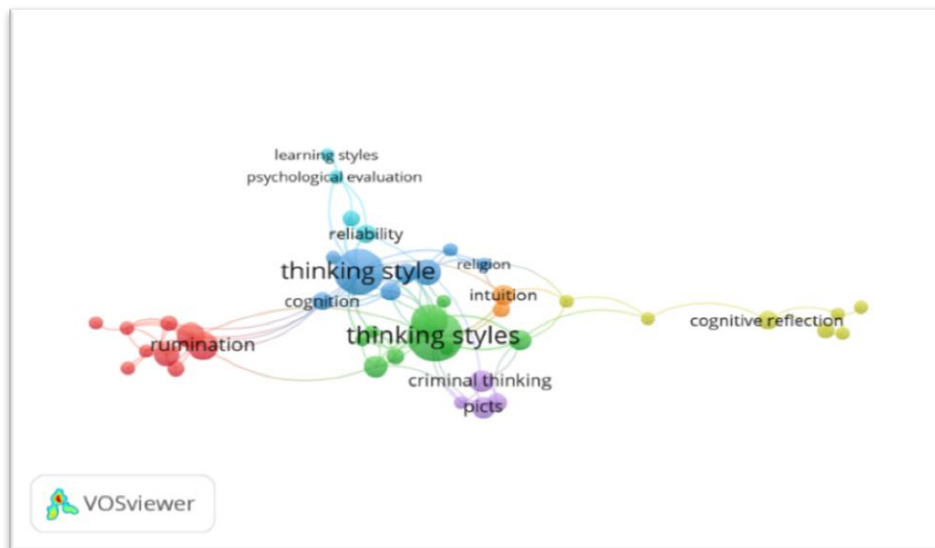


FIGURE 4
CORRELATION OF ARTICLE KEYWORDS AND PUBLICATIONS

DISCUSSION

The correlation analysis of product-moment and different learning and thinking styles has demonstrated a significant relationship between learning and thinking styles. The obtained correlation lied within the range of 0.5–0.7, where the dominant correlation was merely moderate, and the relationship could not be considered strong. One correlation coefficient was less than 0.5, namely the interaction between collaborative learning and internal thinking styles. According to Grasha (2002), students with a collaborative learning style would prefer to learn through sharing ideas and talents. They could work together with teachers and enjoyed the collaboration with their peers, thus demonstrating the ability to work in groups or teams. However, the weakness associated with this learning style is a less-prepared student in facing competitive tasks, dependent-students, which is contrary to the internal style of thinking.

According to Sternberg (1997), individuals with a preference for internal thinking styles tended to be introverted, task-oriented, and self-working. The obtained correlation coefficient lied below 0.39. These results were in agreement with that of the research by Hughes et al. (2000), finding a close moderate relationship between each thinking and learning style. Collaborative style has become the most heavily weighted-learning style since an individual with this kind of style is highly dependent on the other individuals, incompetent, and lack in learning independently (Martinez-Romera et al., 2018). The results exhibited that most of the undergraduate students in the Universitas Medan Area (UMA) tended to apply the collaborative style rather than the competitive style as the learning process model. On the other hand, the executive type had been found to have the highest percentage among the other thinking styles, indicating most of the UMA students favoured to merely obey instructions in resolving the given problems.

When the executive style is applied by smart students, they would tend to strictly follow the instructions. As a consequence, their freedom of thinking and the ability to discover a problem were somewhat limited, thus, a good level of creativity and innovation becoming difficult to be achieved. It has been obtained that the global thinking style with a low overall weight was come out from 38 per cent of the participants. Sternberg (1997) clearly stated that individuals with a global style of thinking would tend to think comprehensively; they have rather foreseen the wide views than focusing on the details. Therefore, someone with a global style is more likely to deal with relatively large tasks which are certainly contrary to the executive style of thinking.

Regarding the bibliometric data, the analyses in the bibliometric data revealed a significant increase in the number of publications associated with the topic of learning and thinking styles since its conceptualization. This trend might be explained by dividing the publication period into two stages. There was only a minimum number of publications during the first stage within the period of 2004–2014 that was ascribed as the initial years of the studies on learning and thinking styles. The second stage which took place from 2015 to 2021 demonstrated a significant improvement each year in the number of articles published about learning and thinking styles. It is noticeable that the most frequently cited article was "Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects" by Shiloh, Salton & Sharabi, (2002), having 130 citations.

On the other hand, the most dominating authors during the period of 2004 – 2021 were Zhang L.F. (total citations counted) and Huang (average citations per document). Personality and Individual Differences was the journal with the highest number of publications associated with learning and thinking styles, with 55 publications totally, while the European Journal of Personality was the most dominating journal (average citations per document). The University of Hong Kong and Tel Aviv University was found as the most dominating institutions based on the total citations counted and average citations per article, respectively. Finally, the United States had the highest total citations, while Finland was indicated as the most dominating country with the highest number of citations per article.

Furthermore, the results of co-citation analysis also revealed that Sternberg and Zhang, L.F. were the two most frequently cited authors on the studies of learning and thinking styles. Six journals featured in the list were found as the most frequently cited journals along with the authors. Therefore, it is conclusively to note that the outcome of this study has provided a comprehensive analysis of bibliometric data and its beneficial role in determining of the most dominating researchers that have had a great contribution of thought on the studies of learning and thinking styles, while also highlighting the growing interest in learning and thinking styles by prominent scholars and institutions globally.

CONCLUSION

The use of bibliometric data and cross-tabulation calculation to analyze the thinking and learning styles of undergraduate students have been studied comprehensively. The thinking and learning styles of all participants in understanding the bibliometric data were analyzed according to Sternberg's thinking styles and Grasha's learning styles. This study revealed the relative dominating factors from each thinking style and learning type. It also exhibited that there were two dominating approaches in learning types, namely collaborative type and competitive type, in which the collaborative type might represent a more strongly high-weighted category as compared with the competitive one. On the other hand, the executive style had been found as the most dominating thinking style relative to the global style. It is imperative that this study also exhibited the most influential authors, journals, institutions, and countries about the research field of learning and thinking models, along with some possible research directions in the future.

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