

THE DEMARCATION OF COGNITIVE AND LEARNING STYLE: MYTH OR REALITY AS AN IMPEDIMENT IN EDUCATIONAL RESEARCH

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Abstract

The fields of cognitive, and learning style research received criticism for their overlapping cognitive, and learning style theory, issues of valid and reliable measures, and potential contribution in applied educational practices. The present review identified differences in their nature, and provided directions for future research in both constructs to make the learning process more fruitful for students in schools, across all levels of education. The need and importance of incorporating both constructs at individual, and group level learning situations, is empirically evident in different studies. The congruence of cognitive or learning style, and the learning environments have boasted significant positive effects on students' academic performance, overall learning, and overall well being. The advancements in the field of information technology, and interactive environments have made matching hypothesis a reality, to deal students according to their learning and cognitive style.

Keywords: Potential of Cognitive Style, potential of learning style, validity of style research, the importance of style research, the future of style research, implications of style research

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Introduction

The origin of the term ‘cognitive style’ is endorsed to Allport in 1937 by most of the researchers, although, he did not use the term cognitive style in his book at that time, whereas the term learning style, was first used by Riessman in 1964 (*cited in Nielsen, 2012*). Research on both constructs, is still growing steadily in spite of criticism by some researchers, and experts (Nielsen, 2012). But, before Nielsen (2012), Kozhevnikov (2007) disparaged the situation of research on cognitive, and learning style as follows:

At the present time, many cognitive scientists would agree that research on cognitive styles has reached an impasse. In their view, although, individual differences in cognitive functioning do exist, but, their effects are often overwhelmed by other factors, such as general abilities and cognitive constraints that all human minds have in common (p. 464).

Further, Kozhevnikov (2007) elaborated the low-level interest of researchers in developing coherent theory, as a cause for the lack of integration, and coordination among different researchers, and a disjointed body of knowledge. This scattered and disintegrated work, by researchers of different disciplines, and regions raised many overlapping concepts and terms. Subsequently, Zhang, Sternberg, and Rayner (2012) considered cognitive, and style research wandered in search of identity. Zhang et al. (2012) used the term intellectual style as an overarching term for cognitive, and learning styles, to defy the opposition, and admitted that “during its long history, the field of intellectual styles has been struggling to find an identity within the larger context of education, psychology, and business literatures” (p. 2). The most puzzled, overlapped terms of cognitive, and learning style, although have their origin in psychology discipline, but due to their extensive use in education, management, medicine, and multi-disciplinary learning environments, has added adversity to the field in terms of development of unified theoretical foundations, even though cross-disciplinary research added huge volumes of information in the field. But, in terms of identity, there are persistent challenges like, a distinctive definition of cognitive and learning style constructs, development of common language, and theoretical foundations embedded in literature of psychology, education and business studies (Zhang et al., 2012). Similarly, Cools (2009a) commented, about the drastic situation as,

“researchers tending to study one part of the whole, but none with full understanding” (p. 8) every one of whom gave a very different description of the characteristics of an elephant after touching its different parts.

In sum, there is a need to establish the spheres, and the domain of these two terms: cognitive and learning style, because different researchers has interpreted learning style, and cognitive style as interchangeable terms (Cools & Bellens, 2012). The main reason for confusion, and misunderstanding in learning/cognitive style research is too much research in an application, and practical sense outside psychology (Cassidy, 2004; Smith, 1997). Along a subsequent quantitative, and qualitative increase of field research, style research became distant from basic psychological theories and concepts. Thus, resulting in many styles as much as researchers, and startlingly most of these styles were unsupported by sound psychological, theoretical frameworks. The motive of style research in different fields, here seemed, just to improve learning in education, medical management, health care, and training industry. Contrary to all above, there were some educational experts in the European Association for Research in Learning and Instruction (EARLI), and the American Educational Research Association (AERA), having doubts, and reservations about inclusion of learning, and cognitive style in routine school learning, and even they do not recognize the due role of individual differences in learning, particularly in relation to style research (Evans, Cools, & Charlesworth, 2010).

Objectives of Study

Subsequently, this review was focused towards the following ends:

1. To determine the nature of cognitive and learning style as constructs.
2. To identify the differences between cognitive and learning style.
3. To establish the worth of cognitive, and learning style research on the base of prevailing literature.
4. To identify future research areas/dimensions to make cognitive, and style research a pragmatic, solid, applicable field of psychology and education.

The related literature to meet above ends was accessed online, mainly from Wiley online library, Science direct, Taylor and Francis online sources. The key terms, cognitive style, theory of cognitive style, the concept of cognitive style, cognitive style and learning style differences, learning style, theory of learning style, and the concept of learning style, were used to find the

related literature. The results were further narrowed down with regard to education and psychology subjects. The search results selected for this narrative review, were only the original research papers or review articles of style researchers from the fields of psychology, and education from peer reviewed journals.

Cognitive Style as Reality

At the start of the cognitive style tradition, Ausburn and Ausburn (1978) considered cognitive style as a persistent psychological distinctiveness of an individual, governed, and linked cognitively to information perception, acquisition, and its processing leading to thinking a solution of a problem. Thus, a cognitive style has dual functions: organization and control of the cognitive process, and its related resources to learn in a learning situation (Messick, 1996). Generally, a cognitive style is a learner's incorporated cognitive process, and cognition based mode of problem solving (Thornell, 1976). In the same effort, some researchers such as Shade (1982), included personality element as one of the dimensions of the cognitive style, and remarked that "the term represents the super-ordinate construct that accounts for individual preferences in various cognitive, perceptual and personality dimensions that influence differences in information processing" (p. 225). However, keeping in view the unique nature of cognitive style, these cannot depend on personality. The cognitive style is considered different, and independent of ability and personality (Peterson, Deary, & Austin, 2005). Therefore, it is one's consistent approach during the thinking process of organization and processing information. It is independent of intelligence, and is responsible for differences in ways of thinking quantitatively and qualitatively (Riding & Smith, 1997). These are cognition based consistent differences that force an individual to exhibit a particular way of thinking, The particular way of thinking which depends particularly on how that person perceives, processes, remembers information in relation to others. On almost same lines, Kozhevnikov (2007) suggested these differences as heuristics which can be grouped with regard to their regulatory function of information processing, from perception to metacognitive processing of environmental information. There are many levels of information processing.

There are different types of control regulations at different levels of information processing, starting from a reception of information to the final stage of information utilization. So possibly, there may be many styles as many regulatory functions, and levels. Therefore, this concept is more generic, and can cover almost all cognitive styles in literature under the term cognitive style.

In terms of individual perspective, the cognitive style is an important factor in determining the student's success in a particular learning environment, and can predict the success of an individual like other constructs such as general intelligence, and other contextual factors, and is an independent construct, from personality, ability (Peterson, Deary, & Austin, 2005), intelligence (Riding & Smith, 1997), learning style, and learning strategies (Smith, 1997). Its independence from above important variables demanded special treatment in teaching learning situations. Therefore, learning material, and teaching methods should be in a match with students' cognitive styles for optimal learning (Kozhevnikov, 2007). The match between the instructional material, and the student's cognitive style improved the student's learning outcomes (Thomas & McKay, 2010). Likewise, the contribution of learning style in academic achievements, was reported by Tinajero, Lemos, Araujo, Ferraces, and Paramo (2012). There was a consistent better performance by the field independent students as compared to field dependent students in academic achievements, and problem solving abilities along a degree of complexity of problems (Nicolaou & Xistouri, 2011; Onyejiaku, 1982; Tinajero & Paramo, 1998a, 1998b). The effect of Cognitive style to behavior was analysed by Riding (1999), and it was found that social behavior problems varied in students from one cognitive style to another cognitive style. Therefore, different training designs should have a space for adjustments of different cognitive styles for optimal learning (Riding & Smith, 1997). Along similar lines, interactions between the student's cognitive style, and teaching methods paved the way for the student's conduct and learning behavior (Riding & Al-Hajji, 2000). Furthermore, it was found that students' performance in different subjects (Riding & Grimley 1999), was affected by their cognitive style, and wholistic imagers and analytic verbalizers were superior to wholistic verbalizers and analytic imagers in performance in the subject of science. The same advantage of cognitive style was evident in a range of motor skills (Riding & Al-Salih, 2000).

Past and current remarkable research in cognitive style construct clearly suggested the cognitive styles' considerations in teaching learning situations. These cognitive styles, alone are responsible for learning outcomes, independent of other factors such as cognitive skills and intelligence (Angeli, 2013; Riding & Agrell, 1997). Moreover, religious beliefs, attitude, and engagements in religious rituals were different among individuals in relation to their differences in analytic cognitive style (Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012). In sum, many decisions, and ways of information processing, and resulted behaviors depend on cognitive style. The same regulatory role of cognitive style in a learning process, and learning efforts is inferred by Bakar and Ali (2013) as, "Educationists should care for cognitive styles because these may inhibit or foster the educational process and efforts. That is why in last 30 years, immense literature has been contributed for this field" (p. 537).

Most literature supported cognitive style matching to teaching methods, and learning in schools. However, some supported the mismatching of cognitive style in teaching learning situations because it will challenge students, and will help them to overcome their style weaknesses, and will prepare them for real life, mismatching situations (Ford & Chen, 2001). In regard to assessment of learning outcomes in schools, there are certain assessment procedures that favour particular cognitive style (Chiu, 2001), so here the assessment may lead to false ends. Martinsen and Diseth (2011) highlighted the correlation of scores on Assimilator-Explorer Inventory to preferences for novelty seeking behaviour, rules and planning behaviour. The role of cognitive style in multi-linguistic knowledge/ability was found to be related to cognitive style, and students' ability to apply grammatical rules of second language were influenced by field dependent preference (Ziętek & Roehr, 2011). Therefore, students' performance assessed in certain behavioral ends should also be deduced in terms of their cognitive style in schools.

Advancing further, the importance of cognitive style differences has a support from neurophysiological, and brain base research. Huang and Byrne (1978) identified relations in analytic, and wholist cognitive style to the hemispheric activity through the lateral eye movement paradigm. Similarly, Oliveri et al. (2012) pointed out the general role of the parietal lobe, and subcortical structures for verbalizer and visualizer thinking/cognitive styles.

The use of multimedia, the internet usage in learning, and training situations, specifically for educational purposes is increasing day by day, and subsequently, the advancements in information technology can help to meet individual cognitive style needs of students. Recently, researchers linked the notion of cognitive style to computer programming, and software development. In this way, it transformed the cognitive style into a more practical construct (Höffler & Schwartz, 2011). Angeli (2013) observed a significant difference in performance of field dependent, field independent, and mixed learners to solve a complex problem through computer modeling. The use of hypermedia learning systems in line to cognitive style preferences improved students' learning (Mampadi, Chen, Ghinea, & Chen, 2011).

The above literature is just the tip of an iceberg. Research in schools and organizational learning environments, neurophysiological field, general cognitive research, and computer research in the learning has proven the worth, and applicability of cognitive style movement to enhance, and accelerate human learning. There are many challenges to cognitive style research, but its importance cannot be ignored and neglected.

Learning Style and Learning in General

Individuals demonstrated differences in the ways they interacted with their learning environment. These individual differences encompass, interacting with the learning material behaviorally to a final storage of information cognitively for future reference or use. In general, these learning differences are regarded as a learning style. Bird, Romanelli, and Ryan (2009) defined the learning style as: "the distinctive psychosocial, affective and cognitive behaviors that give rise to relatively stable measures of perception, interaction, and the response to the surrounding learning environment" (p. 1). The unique learning style remained relatively stable, even when encountered different tasks/situations (Vorhaus, 2010). In other words, when people face a learning situation (stimulus) in a learning environment, and then they respond in their own way (Clark, 2008). Thus, a cognitive style conception as a 'cognition based process' in comparison to the learning style 'ingrained in exterior behavior, and a response to learning a situation' has detached the entwined terms (Doorn, McManus, & Yiend, 2012).

The description of the learning style by Kolb and Kolb (2005) emphasized the cyclic interchangeable, fluxed, dynamic nature of learning style, and theorized the learning style as: “individual differences in learning based on the learners’ preference for employing different phases of the learning cycle” (p. 94). The learning cycle having different phases, described by Kolb and Kolb (2005) included: concrete experience, reflective observation, abstract hypothesis and active testing. On the contrary, Vermunt and Verloop (1999) used term ‘learning style’ as: “a coherent whole of learning activities that students usually employ, and their learning orientation and their conception of learning; this whole is characteristic of them in a certain period of time” (p. 64). But, latter Vermunt and Vermetten (2004) termed their above definition as learning patterns, because of too much presumed instability, and contextuality of their defined construct. In this way it can be concluded that learning styles are somewhat fixed, however, amenable learning characteristics of an individual rooted in past experience, and consequently rendering to approach the learning task with certain cognitive, affective and psychological dispositions that influence both process and output of learning.

On the contrary, there was criticism with regard to validity, and usefulness of learning style construct (Leite, Svinicki, & Shi, 2010; Norman, 2009; Riener & Willingham, 2010; Rohrer & Pashler, 2012). Particularly, Riener and Willingham (2010) considered learning styles practically inapplicable, useless and entitled these as a myth. Whereas, Leite et al. (2010) evaluated VARK learning style inventory (Visual, Aural, Read/Write and Kinesthetic), and reported flaws like poor item selection, and construction. Similarly, Rohrer and Pashler (2012) opposed tailoring instruction to students’ different learning styles, and argued that there is no empirical support for the expensive tailoring of instruction to learning style. In the same way, Norman (2009) claimed that learning style is an obsolete concept, and does little to improve learning. These opposing remarks surmise to a lack of validity in learning style research, and incapability to help researchers to improve the overall learning field scenario.

Nevertheless, even the duskiess of their claims is not as acute as pretended; it was surprising that they pointed flaws mostly in one aspect, a concept or dimension of learning style. Just for examples; Riener and Willingham (2010) pointed Visual, Kinesthetic and auditory, Leite et al. (2010) remarked Visual, Aural, Read/write, and Kinesthetic, whereas Norman (2009)

commented in reference to Visual, Verbal Taxonomy. They neglected a massive literature support for learning style notion, and movement. The scale of learning style publications can be ascertained from the fact that there were 990 publications from 1971-1999, just based only on experiential learning theory, and Kolb learning style inventory (Kolb & Boyatzis, 2001).

There are many studies supporting the claim that students' achievements increased as the result of a match between learning style, and teaching methods (Dunn, 1984). Learning style is a characteristic just like other developmental, and biological characteristic (Dunn, 1989), therefore learning style research cannot be ignored. There are significant differences in learning style in students of different disciplines (Jones, Reichard, & Mokhtari, 2003). Moreover, students' learning patterns has explained the variance in their academic performance (Vermunt, 2005). Further evidence was from Threeton and Walter (2009), and they identified that different learning styles were related to personality types. Moreover, matched teaching methods, and learning styles increased students' retention ability (Slack & Norwich, 2007). By using advancements of information technology, Akbulut and Cardak (2012) has claimed that adaptive educational hypermedia models based on learning styles, helped students to achieve success, and satisfaction. Alike, in normal classes, an educational process aligned with students' learning styles, increased their satisfaction (Lurea, Neascu, Safta, & Suditu, 2011). Similarly, Miller (2005) identified 40 publications that found a significant effect of matching Gregorc Style Delineator (GSD) to a computer based instruction, and reported that this matching improved students' learning. On the other hand a mismatch gave rise to problems in students' interaction with courses/ learning situations (Kinshuk, Liu, & Graf, 2009).

Adding to the worth of learning style construct, Ozgur, Temel, and Yilmaz (2012) confirmed the relationship between students' problem solving abilities, and their scores as assimilators, and converges on Kolb LSI. The link of students' visual style to consequent learning strategies (Mehrdad & Ahghar, 2012) brought learning style to the limelight. The applicability of learning style construct was corroborated by Huang, Wu, Yang, and Hwang, (2012), who developed portfolio-based programming learning style diagnosis system for Felder's learning style. Likewise, D'Amore, James, and Mitchell (2012) endorsed a relationship between students' learning style, and demographic data. While discussing teachers' own learning style, and their teaching methods;

Hurst-Wajszczuk (2010) argued that teachers can shape their teaching style to minimize negative effects of their own learning style on students' learning.

Alaoutinen, Heikkinen, and Porras (2010) utilized an intensive collaborative teaching concept, CODE CAMP to demonstrate the effect of learning style on students' learning behavior. Their study ratified an increase of motivation to learn in reflective- intuitive students. Similarly, memory capacity, which is an important factor in human learning was found to have a relationship with students' learning style (Graf, Lin, & Kinshuk, 2008; Graf et al., 2009). Briefly, the learning style has been emerged as an important variable to explain the students' performance along other variables. Furthermore, Azizi, Noordin, Sharifuddin, and Talib (2011) uncovered that methods used to teach students had a significant relationship to their reported learning styles. The aforementioned amenability of a learning style was justified by Caulley, Wadey, and Freeman (2012), who reported a change in students' learning styles from action oriented learning towards more reflective learning in subsequent years of higher education, and with an increase in age. In this way, learning style change has linkage to other elements of teaching and learning process.

About the issue of measurement, Cook, Thompson, Thomas, and Thomas (2009) found empirical support for the theoretical model of Vermunt's learning style inventory. Furthermore, Cook and Smith (2006) found ILS (Index of learning styles) a valid instrument of learning style, and also rejected the assumption of similar definitions of cognitive, and learning style to be the same concepts, and possibility of their use as interchange terms.

The promising, and the propitious role of learning styles in learning was elaborated by Evans and Smith (2006) in a following way:

“The application of learning style theory and research continues to hold great promise for practitioners in both education and training as a potentially powerful mechanism for enabling pupils, students and trainers to manage their own learning better throughout educational and working lives” (p. 77).

Thus we concluded that the role of a learning style in an individual's learning in classrooms, social settings as well as in lifelong learning, cannot be neglected and left unattended. In this regard, the point of view of Bakar and Ali (2014), is that learning style being having a massive influence on individuals' way to learn in formal and informal settings have proven themselves, a reality, and no more a myth. This exploratory study advocates and supports the

sedulous research until now, to fathom the individual learning differences in perspective of learning style.

Cognitive, and Learning Style with their Unique Perspectives

Although, it became clear from the above discussion that the terms cognitive and learning style have different origin and theoretical background (Cassidy, 2004), leading to different nature and contribution, still both terms were used without any discrimination (Evans et al., 2010). Thus, a cognitive style is independent from a learning style, and learning strategies (Smith, 1997). Both cognitive and learning style measure different constructs, irrespective of the fact that they have many analogous styles (Cook & Smith, 2006). In spite of being different constructs, the imprecise use of learning style as an umbrella term to connote both learning, and cognitive style is observed on some occasions (Evans et al., 2010). The Hartley (1998) distant two terms in a way that, “cognitive style is characteristically an approach to different cognitive tasks” (p. 34), and is, “preferred manner of perceiving, remembering and thinking” (p. 41). Whereas, he described learning style as follows: “ways in which individuals characteristically approach different learning tasks. Learning styles might be more automatic than learning strategies, which are more optional” (p. 149).

Another difference in both terms was in their nature, and the number of style elements. Majority of cognitive style models present bipolar styles discussed in theoretical or academic research, on a contrary, most learning styles deviate from bipolar nature, and are discussed in practical applications (Liu & Ginther, 1999). In a sense of contextual dependency, a cognitive style was more structured, and independent of learning situations as compared to a learning style (Cassidy, 2004). It became clear that both were developed on different theoretical perspectives, so scores of similar labels of cognitive, and learning style cannot be interchanged (Cook & Smith, 2006). Thus, cognitive style is deduced as an individual’s distinctive cognitive processing, whereas characteristic mode or way adopted to learn in a learning situation learning style. The cognitive style being a multiple of cognitive processes, include problem solving, thinking and remembering, which are extinct and rare components of a learning style (Slack & Norwich, 2007).

Armstrong, Peterson, and Rayner (2012) conducted a Delphi study to develop, the agreed upon definitions of cognitive style, and learning style through involving renowned researchers, and practitioners of style research. An individual difference in preferred ways of processing information through the cognitive-brain based mechanisms was generally considered as a cognitive style. The examples of such processes were perception, organization, and analysis of information. These styles have subsequently affected learning behavior, and problem solving abilities. In this way a cognitive style, was relatively stable, and possibly an innate construct. On the other hand, different learning styles were individuals' preferred ways of responding having cognitive, and behavioral dimensions. These much change to the environment, and context. They affected the motivation, and attitude of learning, and determined the performance.

In the preceding discussion, learning, and cognitive styles appeared as different constructs, and each of these required a different approach, and treatment to reveal the mysteries of human learning.

Future Avenues of Cognitive Style Research

Research methodology, valid and reliable measurement tools, theoretical grounds in psychology, cognitive theories, and application issues of proposed frameworks, and models to the actual classroom/ organizational situation, are gray areas identified as challenges for future cognitive stylistic research. The past cognitive style research relied heavily on deductive research methods involving self-report instruments, as the data collection tools in majority studies. There was a rare use of longitudinal, multi-source, multi-method research designs to explore the field of cognitive style. Therefore, to advance into the realm of cognitive style founded in pragmatism, it is needed to focus on conceptual clarification, overarching in the context of other individual differences with multi-method, multisource approaches in line with collaboration of research in different regions (Cools, 2009b).

The group embedded figure test, used to discover the field independent, and field dependent cognitive style was criticized by O'leary, Calsyn, and Fauria (1980) for its validity. Similarly, Riding's Cognitive Styles Analysis was assessed as psychometric instrument, and its test retest reliability was found to be inadequate (Cook & Smith, 2006).

Style researchers have not done enough effort to resolve the issues of criticism, overlapping terminologies, and valid measurement. The decisions related to child education, and children grouping based on their cognitive styles, should be taken after validation of cognitive style measurement/instrument. The questions about the psychometric strength of all available cognitive style measures should be answered (Peterson, Rayner, & Armstrong, 2009). The cognitive style research should be supported by the advancements in other fields, and areas of psychology. Blazhenkova and Kozhevnikov (2009) incorporated the developments in the human visual system to cognitive style, and extended the imagery-verbal model to Object-Spatial Imagery, and Verbal cognitive style, in line with dimensions of old visual verbalizer style. Similarly, Thomas and McKay (2010) investigated verbalizer-visualizer styles, and their measurement and proposed a new dimension to visual-verbalizer bipolar cognitive style. Therefore, future research should question, and evaluate bipolarity of different cognitive styles because everyone is gifted with some degree of each style dimension (Evans & Smith, 2006). Likewise, Kozhevnikov et al. (2002, 2005) discovered that the human visual system has distinct systems to process the object properties, and spatial properties. Hence, they recommended that future research should develop frameworks to help people for propensity to use one kind of style dimension, and subsequently to perform poorly in other imagery dimension.

The role of social environment in the development of different cognitive styles is crucial. Researchers found empirical evidence that a field independent, and the field dependent cognitive style, originates, and develops in a social environment, and social setting. The field dependent children became field independent with exposure to technology, culture and experience (Bagley & Mallick, 1998). The prediction ability of working memory in the prediction of learning outcomes in different subjects was identified by Alloway, Banner, and Smith (2010). The future style research should explore interventions to help students with low working memory through interaction between cognitive style designs and strategies.

There are some other individual differences responsible for school success along cognitive, and learning styles, and subsequently these can minimize or maximize the effect of cognitive styles in school learning (Tinajero & Paramo, 1998b). Therefore, researchers should explore the relationship between cognitive styles, and motivation, attention, self-regulation, self-

efficacy, and emotions (Nicolaou & Xistouri, 2011). In terms of motor skills, Riding and Al-Salih (2000) found that cognitive styles were practically important for a range of motor skills leading cognitive style research to the field of sports psychology. Kozhevnikov (2007) identified integration of different cognitive styles into unified theory embedded in cognitive, and neuropsychological research; developing frameworks for solutions to bipolar constraints; exploring the relationship with personality, and environment, and development of models for strategy choice, and adaptability as a future research plan for cognitive style researchers.

Learning Style Research, and Optimal Learning

Excessive learning styles, their definitions, and measurement instruments have baffled researchers, practitioners, policy makers, and have developed doubts and, reservations among anti-style researchers. Better knowledge of learning styles accompanied with advancements in information technology can be beneficial for optimal learning of different types of students in large size classes. A limited research confirming relationship between learning styles, and learning outcomes has resulted in opposition, and in hesitation to apply learning style research beyond experiments in actual classroom settings (Threton & Walter, 2009).

In the above situation, researchers have questioned about the theoretical validity of different learning styles. Slack and Norwich (2007) conducted a study about theoretical justification of Smith Model (1998). Pupil self-report inventory was used for the exploration of the pupil's learning style. They claimed that this model lack theoretical background, and justification for labeling in to auditory, kinesthetic and visual styles. Slack and Norwich (2007) cautioned about the over generalization of learning styles into mutually exclusive styles, and warned that it can lead to false, and wrong expectations from pupils. Moreover, further arrangements on the base of these mutually exclusive styles could provide improper learning opportunities. Miller (2005) considered LSI (Kolb) a poor instrument in terms of measurement.

Bergsteiner, Avery, and Neumann (2010) applied standard modeling categorization criteria to Kolb's basic model which alone was used in 990 studies from 1971-1999 (Kolb & Boyatzis, 2001). The researchers claimed to identify errors in fundamental graphic syntax, incapability to pass the modeler's

graphic sufficiency, and simplification tests, and found problems related to categorization and definitions (*see detail in Bergsteiner et al., 2010*).

Therefore, there should be research to identify the ways to overcome these modeling flaws in fundamental, and the basic leading learning style models. Suggestions, and ways should be explored to improve the situation. Kolb's learning model, Felder and Solomon's Model are largely used in management, and education for a wide range of applications. The psychometric strengths of Kolb learning style inventory, and Felder and Solomon's Index of Learning Style was investigated by Platsidou and Metallidou (2009), and the LSI was found to report satisfactory reliability, and a weak construct validity for the Greek sample. Moreover, there was the strong preference for only accommodating, and divergent learning styles. Subsequently, ILS only achieved an acceptable level of reliability with the ability of discrimination, and construct validity. The study suggested that these two could not be used for grouping students in reference to their learning styles, but can only be allowed to encourage self-development of an individual. Furthermore, Brew (2002) reported about gender sensitivity of Kolb LSI (1985) for the sample of Australian university students. Similarly, Reio (2006) examined the psychometric properties of the Gregoric Style Delineator (GSD), and found that GSD's theoretical basis/design has little statistical support, and failed to depict one's cognitive learning style. Slack and Norwich (2007) in a classroom-based study reported internal, and re-test unreliability of kinesthetic learning scale in auditory, kinesthetic, and visual learning style inventory.

Zwanenberg, Wilkinson, and Anderson (2000) investigated the reliability of two well recognized learning style descriptors: Felder & Silverman's index of learning, and Honey & Mumford's learning style questionnaire. ILS showed low internal reliability, and failed to predict. Furthermore, ILS was found mixed with cognitive, and learning style characteristics, and measures absolutely none of both. They advised not to execute its application beyond engineering students for whom it was intended at the start. LSQ found more reliable internally than ILS, but it was also unable to possess predictability, and was also not up to the standard of psychometric instruments. Busato, Prins, Elshout, and Hamaker (1998) claimed that Vermunt's learning styles do not have considerable evidence to tailor higher education to Vermunt's learning styles, and suggested further research to validate these styles.

Moreover, with regard to a correlation between culture and learning style, learning style was not culturally structured but contextual (Wong, 2004). It may be inferred, that learning style may be modified by experience, context and exposure. Personality, education, profession, job role, and individual adaptive competencies were responsible for shaping the learning style along Kolb's learning style classification (Kolb & Boyatzis, 2001). Vermunt (2005) found the relationship of a student's learning patterns to their academic disciplines, prior education, age and gender. Moreover, internationalization at a higher education level is evolving field, and it requires research on culture specific styles of learning through reliable, and valid measures to develop an emerging field of international pedagogy (Eaves, 2011).

Hall and Moseley (2005) gave directions for too much debated cognitive, and learning style field as follows:

“The learning style research should help the individual overcome a particular style so focus should be on strategies rather than giving labeling an individual with a style, because it limits the learner's ambition, descriptions of learning style should be tools to break chains of habit and limitation” (p. 254).

These guidelines, still seems to be a guideline, and an agenda for future research on learning style.

Overall Discussion

Although there was criticism, doubts about the validity of cognitive, and learning style research (Cools, 2009a; Kozhevnikov, 2007), but an increase in quantity, and quality of cognitive and learning style research (Nielsen, 2012) favored, the argument that researchers believed in cognitive, and learning style research to solve the mysteries of human learning. Likewise, confusion, and misunderstandings about learning/cognitive style research was depicted by Cassidy (2004), and Smith (1997). However, it also showed an acknowledgement of huge research in learning/cognitive style. Moreover, Armstrong, Peterson, and Rayner (2012) in their delphi study has developed consensus among educational psychologists in the field, and doubts about coherent theory, and a common language of learning/cognitive style research has been wiped out. In the same way, Education, Learning, styles, Individual Differences Network (ELSIN) has played a vital role to develop consensus

among style researchers about the use of different terms of the field. Furthermore, researchers have described differences between cognitive, and learning style (Armstrong, Peterson, & Rayner, 2012; Cassidy, 2004; Cook & Smith, 2006; Smith, 2001), and has counted these as separate constructs.

Additionally, cognitive and learning styles have differences in terms of their time of origin (Nielsen, 2012) as well as has differences in their theoretical foundations (Cassidy, 2004), and as well in their nature in terms of application, and being bipolar or not (Liu & Ginther, 1999). Therefore, cognitive and learning style should be equally considered important like other contextual, and personal variables playing a key role in students' learning (Dunn, 1989; Kinshuk et al., 2009; Peterson et al., 2005; Riding & Argell, 1997). It appeared that confusion of definitions, and theoretical foundations is past. The matching hypothesis of cognitive, and learning style and students' learning environment to enhance students' learning outcomes has empirical evidence (Akbulut & Cardak, 2012; Angeli, 2013; Nicolaou & Xistouri, 2011; Riding & Al-Salih, 2000; Thomas & McKay, 2010; Tinajero et al., 2012).

The studies of Thomas and McKay (2010), and Kozhevnikov et al. (2002, 2005) have showed possibilities to incorporate advancements of neuro-physiological, mind, and brain sciences, into cognitive and learning style research. There is a need to explain cognitive and learning style in perspective of socio-cultural set up, and to explain different social behaviours based on the cognitive and learning style (Bagley & Mallick, 1998; Bird et al., 2009).

Conclusions

In short, future style research should be in the direction of exploration of transitions in learning style at various life stages, devise ways integrated with pedagogical frameworks, interaction with individual learning differences, and personality leading to evidence based publications (Evans et al., 2010). There is a need to devise feasible frameworks, and pedagogies embedded in learning style concepts supported by the advancements in information technology (Baker, Jensen, & Kolb, 2002; Miller, 2005). Therefore, the future research should be cemented to other psychological fields, and should provide workable suggestions to help students, teachers and adults through overcoming the measurement issues.

Limits of the Study

The studies selected for this study were only from Wiley online library, Science Direct, Taylor and Francis online data sources from subjects of education and psychology. The reviews by leaders of the field, and the original research papers were selected for this review study. The present study was limited to a narrative review of the selected papers in order to identify, and solve qualitative differences, and agreements in cognitive/learning style research. Therefore, future research should use meta-analysis techniques to develop a holistic view, and quantification of the impact of cognitive, and style research across multiple studies from published and unpublished sources.

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