TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 37, 2022

A new decade for social changes

ISSN 2668-7798

www.techniumscience.com

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Learning styles of architecture and interior design students: a review of the literature

Kaba Imene[1], Abdou Saliha[2]

[1]Department of Architecture, University Benyoucef Benkhada, Algiers, Algeria,
[2]Faculty of Architecture and urbanism, University Salah Boubnider, Constantine, Algeria

Kaba-imen@hotmail.com, saliha.abdou@univ-constantine3.dz

Abstract. Although much has been written about the teaching of architecture, little progress has been made to improve pedagogical approaches. However, there is a consensus in the literature on the fact that educational practices in architecture are old approaches rooted in the traditions of fine arts schools, and the fact that the shift from the teaching paradigm to the learning paradigm places the student central in the learning process. This research is a systematic review of recent literature; it aims to examine the literature of the past 20 years on the learning styles of architecture and interior design students, and the effects of learning styles on their performance scores. The findings reveal the importance of knowing the learning styles to help teachers to adapt a good teaching approach appropriate to improve the academic performance of students, link between learning styles of architecture and interior design students and the pedagogical approaches adopted, and the role of the teacher in changing student learning styles.

Keywords. Educational architecture, Index of Learning Style of Felder and Soloman (ILS), Kolb Learning Style Inventory (KLSI), Learning style.

1. Introduction

Different terms have been used in literature such as learning style, cognitive style, sensory preference, and personality types. Some of these terms, in some instances, have been used interchangeably, while in other occasions they have been differentiated (Cassidy, 2004). Mortimore (2003) makes a distinction between learning styles and cognitive styles. He indicates that learning styles are seen more as strategies learners use facing learning and are seen as less stable. In contrast, cognitive styles are relatively stable. Thus, learning styles, as opposed to learner preferences, can be stretched over time. Dunn, who has conducted long-term studies on learning styles, defines it as how each learner begins to focus on, process, absorb and retain new and difficult information (Dunn & Dunn, 1992; 1993), according to her, learning styles are the use of different and specific ways by each student to prepare to learn, learn and remember new and difficult information" (Dunn & Dunn, 1992). During the learning process, students exhibit different styles through which they observe, feel, and interpret information. Personal preferences while learning are described as one's learning style, and different individual learning styles can be developed based on one's abilities and preferences (Chen &al, 2005).

Learning style theories show that individuals learn in different ways (Claxton & Murrell, 1987; Kolb, 1985). Each learning style has its own strengths and weaknesses, but that does not mean that one is better than the other (Demirbas & Demirkan, 2003).

Research confirms the importance of addressing learning styles in the development of education, particularly in areas related to design and engineering (Mills et al, 2005; Felder & Silverman, 1988). Knowing the learning style preferences of students allows higher education instructors to adopt an appropriate pedagogical approach to improve students' academic performance (Felder, 1993).

According to Cassidy (2004), over the past four decades, many studies have been conducted on learning styles. Coffield et al (2004) identified over 70 learning style theories developed over the past three decades. Several models of learning styles have been developed, but five of them have been studied in the engineering education literature (Honey and Munford, Myers-Briggs, Dunn and Dunn, Kolb, and Felder and Silverman) (Felder & Brent, 2005). Our research limited to the following two most applied models in the teaching of architecture and interior design: Kolb's experiential learning styles model and the Felder-Silverman model.

Kolb's learning styles model is supported by Kolb's Experiential Learning Theory (ELT), a comprehensive theory of adult learning and development (Kolb, 1984). For Kolb (1984) and Kolb & Kolb (2013) learning must be considered as a process and not only for the results obtained. It is therefore facilitated when students have the opportunity to test and retest their beliefs, knowledge and ideas on a given subject, and to add new and refined ideas. In order to measure learners' learning styles, Kolb developed the Kolb Learning Styles Inventory (KLSI). Six versions of this inventory have been published over the past 40 years (Kolb & Kolb, 2013). The KLSI identifies four learning styles types: Accommodating, Assimilating, Converging and Diverging.

Richard Felder and Linda Silverman formulated in 1988 a learning style model designed to capture the most important learning style differences among engineering students and provide a good basis for engineering instructors to formulate a teaching approach that meets the needs of learning of all students (Felder & Silverman, 1988; Felder, 1993). The ILS (Learning Styles Index) was therefore developed as an instrument to identify learning styles (Felder & Silverman, 1988). This instrument, which has undergone several reformulations (Felder & Soloman, 1991), classifies learners as having preferences for one category or the other in each of the following four dimensions: Sensitive/Intuitive, Visual/Verbal, Active/Reflective, and Sequential. /Global.

This paper examines the literature on the learning styles of architecture and interior design students and the impacts that the learning styles might have on their performance scores.

This review aims to: investigate the application of learning style theories in architecture and interior design, explore what may be related to learning styles, and explore the possibility of developing the teaching of architecture by helping teachers select the right teaching technique.

2. Methodology

This research is a systematic review of recent literature. Data collection and analysis were informed by published work on systematic review (Khan et al. 2003).

More specifically, a five-step process was adopted: (1) scoping of research objectives; (2) identify relevant studies; (3) assess the quality of the studies; (4) summarize the evidence; and (5) interpret the results. In accordance with these guidelines, searches and reviews of peer-reviewed journal articles and conference papers were conducted between January and December 2019 using the online database Scopus, which was chosen because of its wide journal

coverage and special features in keyword research and citation analysis. Three search terms were used to find published research: “Learning Styles”, “Learning Style Inventory” and “Architectural Education”. The selection of search criteria was based on the need to capture relevant and current evidence-based literature on the topic. Only papers published within the past 20 years (2003-2022) were included except the paper by Newland et al, (1987) which provided valuable reference.

A total of 29 items were found on the application of an instrument for measuring learning styles in the teaching of architecture and interior design. The initial screening involved reviewing the titles and abstracts of 29 of the articles. This selection made it possible to identify the full texts that would be included in the review and was based on an evaluation criterion: the level of relevance of the article in relation to the research objectives of the study. From this selection, only the articles that used the KLSI, and ILS Felder and Silverman, were selected discarding the paper that used other instruments (Honey and Munford, Myers-Briggs, Dunn and Dunn, and VARK). Through this process, only 16 articles were found to be relevant to the topic under study. Each selected article was reviewed, and narrative and quantitative synthesis were produced. The narrative synthesis consists in describing the results of the descriptive analyze carried out from the extracted data by focusing on the coherent group formed by the included studies describing the similarities/differences between them. Quantitative synthesis, on the other hand, consists of using statistical methods in order to obtain an overall measure from similar statistical measures from studies that have quite similar characteristics. SPSS software was used in this paper to perform these statistical analyzes.

3. Results and discussion

3.1. Summary tables

Before moving on to the analysis of the literature review, we considered it is important to present two summary tables. The first (Table 1) highlights the objectives of the selected research. It gathers the authors of this research according to similarities in the objectives, and the instruments for measuring learning styles. The second table (Table 2) gives more details regarding the research mentioned in the first table. It specifies certain parameters relating to the methodology (sampling, collection and analysis of data), and gives an overview of the results of this research.

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Tableau 1: First summary table of architectural research that uses learning style measurement instruments (KLSI and ILS)

Instrument for measuring learning styles	Research objective	Author	Year
Kolb's Learning Styles Inventory KLSI	Identify learning styles	Demirkan & Demirbas	2008
		Tucker	2007
		Tucker	2008
	Explore link between thinking development and learning styles	Carmel-Gilfilen	2012
	Reveal the link between learning styles, perceptions and cultural biases	Newland et al	1987
	Combining learning styles and visualization skill	Nussbaumer	2000
	Finding the link between learning styles and performance assessment	Demirbas & Demirkan	2003
		Kvan &Yunyan	2005
		Tezel & Casakin	2010
	Explore link between: learning styles, performance evaluation and age	Tucker	2009
	Explore link between : learning styles performance assessment and gender	Demirbas &Demirkan	2007
The Felder Soloman Learning Styles Index ILS	Identify learning styles and compare students	Labib et al	2019
	Finding the link between learning styles and performance assessment	Demirkan	2016
	Finding the link between: learning styles performance assessment and gender	Fulani et al	2016
		Demirkan & Demirbas,	2010
	Combine learning styles and spatial ability of students	Mostafa & Mostafa	2010

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Tableau 2: Second summary table of architectural research that uses learning style measurement instruments (KLSI and ILS)

Author and year	Methodology		Data analysis	Results
	Sample	Instrument		
Demirkan & Demirbas, 2008	286 freshmen students (interior design)	KLSI	Descriptive statistics	Freshmen design students have balanced learning styles
Tucker, 2007	104 freshmen and 48 third-year students (architecture)	KLSI	Descriptive statistics and Inferential statistics	A statistically significant relationship between learning styles and grade. Learning style changes as students progress through their studies
Tucker, 2008	152 undergraduate students and 26 teachers (architecture)	KLSI	Descriptive statistics	Changes from student learning styles to teacher learning styles as they progress through their studies
Carmel-Gilfilen, 2012	139 students at several levels (architecture)	The Perry scheme and KLSI	Descriptive statistics and Inferential statistics	The presence of all learning styles with a preference for divergent and accommodating learning. No association between learning style and thinking development. An insight into how design students approach thinking and learning
Newland, et al, 1987	45 architects	KLSI and ICLI	-Descriptive statistics	A four-pronged strategy for information transfer will lead to more successful communication with architects
Nussbaumer, 2000	578 students at several levels (interior design)	KLSI, and Isham's Visualization Skills Test	Descriptive statistics and Inferential statistics	Link between learning styles and visualization skills
Demirbas & Demirkan, 2003	88 freshmen students (architecture)	KLSI	Descriptive statistics and Inferential statistics	Statistically significant differences between the performance of students with different learning styles at different stages of the design process

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Kvan &Yunyan, 2005	91 undergraduate students (architecture)	KLSI	Descriptive statistics and Inferential statistics	A statistically significant correlation is found between learning styles and performance
Tezel & Casakin, 2010	90 students (interior design)	KLSI	Descriptive statistics and Inferential statistics	Consideration of individual differences between students and the implementation of experiential learning theory, can contribute to the improvement of individual skills and abilities in different design situations
Tucker, 2009	104 freshmen and 48 third-year students (architecture)	KLSI	Descriptive statistics and Inferential statistics	Changes in learning styles during studies. These changes reflect a statistically significant relationship between learning styles and academic performance in design work.
Demirbas &Demirkan, 2007	freshmen students (architecture)	KLSI	Descriptive statistics and Inferential statistics	Learning style preferences significantly did not depend on gender. Men's performance scores are higher in technology-based courses, while women's scores are higher in arts and foundation courses and in semester academic performance scores.
Labib et al, 2019	92 freshmen (architecture and interior design)	ILS	Descriptive statistics	There is no significant difference in learning styles between architecture and interior design students
Demirkan, 2016	118 freshmen and 100 fourth-year students (interior design)	ILS	Descriptive statistics	Identifying and positioning the elements of a particular learning style leads to better planning of teaching methods and better selection of relevant content and sources in design workshops.
Fulani et al, 2016	50 freshmen students (architecture)	ILS	Descriptive statistics and Inferential statistics	Freshmen students, regardless of gender, were well balanced in their learning styles across the different scales. Performance scores varied by learning styles only on the active/reflective subscale and by gender to the advantage of women.
Demirkan & Demirbas, 2010)	100 fourth-year students (interior design)	ILS	Descriptive statistics	A fairly balanced learning style preference across all scales, with a moderate to strong preference on the visual scale and a weak preference on the global scale. Learning styles and gender are independent for design students at all scales. The active/reflective scale is the most dominant scale in design education

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Mostafa & Mostafa, 2010	70 undergraduate students (architecture and other specialties)	ILS and Newton and Bristoll's Spatial Aptitude Test	Descriptive statistics	Architecture students exhibit higher spatial abilities and generally learn more visually and actively than the average student. A higher correlation between strong spatial ability and visual learning, to a high degree, and strong spatial ability and active learning to a lesser degree.

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

3.2. Synthesis of summary tables

Analysis of the papers using matrices of common themes and results suggested that analysis of the literature review can best be discussed within the contexts of four groups: (1) objectives of use measuring learning styles instruments (KLSI and ILS), (2) sampling categories, (3) type of data analysis; and (4) category's result.

3.2.1. Objectives of use measuring learning styles instruments (KLSI and ILS)

From these two summary tables presented previously, four groups of research using instruments for measuring learning styles (KLSI and ILS) can be identified. Through this grouping, we have tried to bring together researches that have common methodology and one objective or more. These four groups are: (1) identifying learning styles, (2) comparing the learning styles of two groups, (3) link the learning styles to one parameter; and (4) link the learning styles to two parameters.

- **Identifying learning styles :**

According to the findings, as seen in Figure 1, 87,5% of researchers have attempted to identify the learning styles of architecture or interior design students, and 12,5% have identified the learning styles of practicing architects or teachers of architecture. This reveals a great interest in identifying the learning styles of students in the learning process.

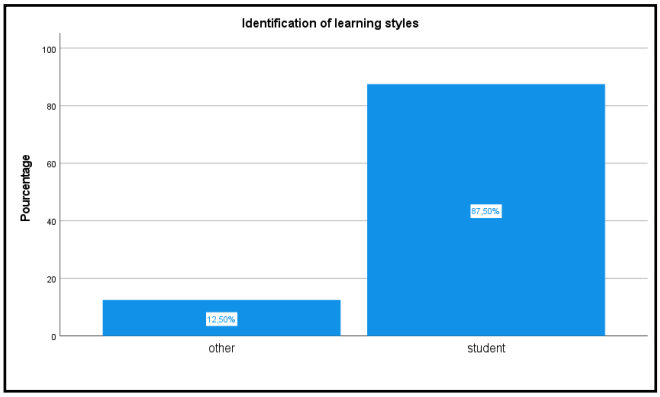

Figure 1: Identification of learning styles

- **Comparing the learning styles of two groups:**

As seen in Figure 2, according to the findings of analysis, only 31.25% of the researchers compared the learning styles of two groups, 68.75% were not in this comparative perspective. Here, we can say that comparing groups is not a priority for all researchers.

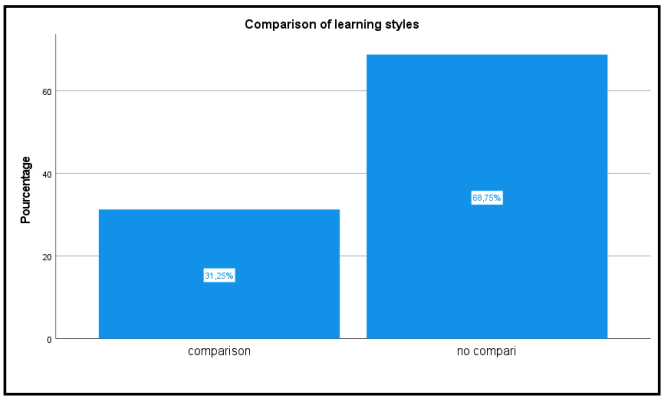

Figure 2: Comparison of learning styles

- **Link the learning styles to one parameter:**

According to the findings of the analysis of literature review, as seen in Figure 3, 50% of the researchers have chosen to link the learning styles of the students and another parameter (skills of visualization, performance,…), based on the objectives of their researches.

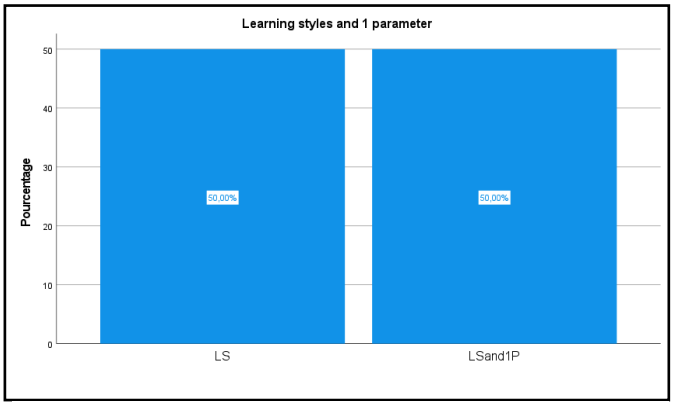

Figure 3: Link the learning styles to one parameter

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

- **Link the learning styles to two parameters:**

As can be seen in Figure 4, 25% of the study sample focus on the link between learning styles and two other parameters, such as performance evaluation and age or performance evaluation and gender

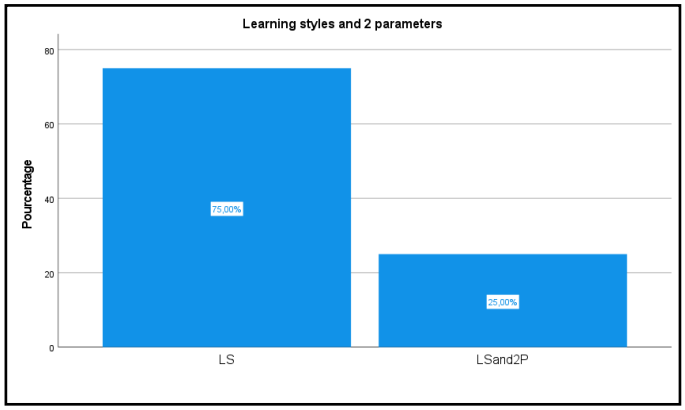

Figure 4: Link the learning styles to two parameters

3.2.2. Sampling categories

The two summary tables presented above also allowed us to identify similarities and differences in the researchers' samples. In fact, we were able to identify 5 types of samples in all researches, which are: freshmen students, undergraduate students (1st, 2nd and 3rd years), students from several levels combined, students from fourth year, and others (teacher and architects). Reading Figure 5 indicates that the choice of researchers concerning their samples goes to undergraduate students with a percentage that is close to 60% (29.41% of first-year students, and 29.41% of students in 1st, 2nd and 3rd years), while the choices of second cycle students represent only 5.88%.

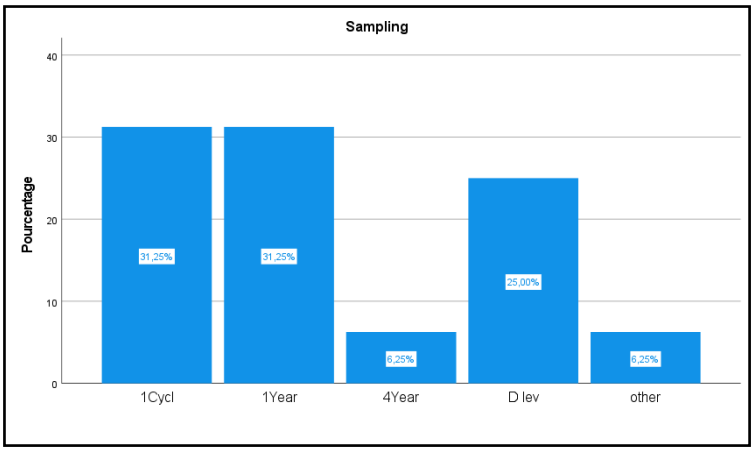

Figure 5: Sampling in the literature review

3.2.3. Type of data analysis

Two types of statistical analysis were used in the research for this literature review: descriptive analyzes and inferential analyzes (Figure 6). 43.75% of the researchers used descriptive analyzes of the data, using the tools available to the researcher to carry out this type of analysis, and which are divided into three main categories: measures of central tendency (mode, median, mean,…), dispersion and position measurements (standard deviation, variance, range, minimum, maximum,…), as well as frequency analyzes (absolute frequency, relative frequency). 56.25% of the researchers did not stop at the descriptive analyses level, they also carried out inferential analyzes of the data, and mainly the t-tests (to determine the difference between the means of two populations, and this, in relation to a

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

predetermined variable), and analyzes of variance ANOVA (to examine a quantitative variable to be explained in terms of the effects of one or more nominal variables, that is, in terms of categories).

The choice of analysis type depends on researcher's objectives, since descriptive analyzes essentially aims to describe the characteristics of a sample and answer research questions (Fortin & Gagnon, 2015), and inferential analyzes tend to generalize the results obtained from a sample to the entire population from which it was drawn (Amyotte & Côté, 2017).

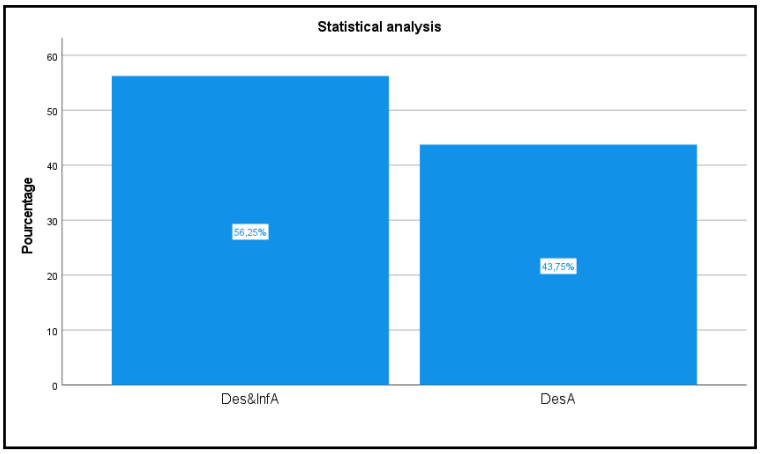

Figure 6: Type of data analysis in the literature review

3.2.4. Category's result

To conclude this synthesis, by gathering similarities found in the results, we highlighted the following three points: (1) the importance of knowing the learning styles, (2) the learning styles of architecture and interior design students and the pedagogical approaches adopted; and (3) the role of the teacher in changing student learning styles.

- **The importance of knowing learning styles**

All of the researchers in this literature review agree on the importance of identifying students' learning styles. They confirmed that identifying and positioning the elements of a particular learning style leads to better planning of teaching methods and better choice of relevant content and sources in design studio. This finding is also confirmed by Ldpride, 2012; Khurshid & Mahmood, 2012; Abidin et al, 2011; and Christou & Dinoy, 2010, who insist on the advantages of identifying learning styles for teachers and students.

- **The learning styles of architecture and interior design students and the pedagogical approaches adopted**

This literature review demonstrated that architecture and interior design students have balanced learning styles, and students who have different learning styles at different stages of the design process perform better.

This leads us to ask questions about the modes of learning that are offered in the teaching of architecture. Kolb (1984) has also mentioned this point. According to him, different modes of learning are found within professions which are multidisciplinary and require various skills. This is the case for architecture, which is a multidisciplinary field. Architects need a variety of thinking skills from artistic (right-brained, creative), to engineering (left-braid makers). The same for Nussbaumer (2001), who argues that architecture and interior design are among the professions that are multidisciplinary and require varied skills. According to her, architects and interior designers must use left-brain abstract thinking and right-brain concrete thinking. They must have imaginative capacity, analytical skills, decision-making skills, and management and business skills.

Therefore, since all learning styles have been found in architecture and interior design students and students should have a variety of skills, teaching should accommodate all learning styles. The implementation of certain learning theories, such as the theory of experiential learning which takes into account individual differences between students, can contribute to the improvement of individual skills and abilities in different situations in architectural education, and more specifically in design education (Demirbas & Demirkan, 2003; 2007).

- **The role of the teacher in changing student learning styles**

The literature review confirms the presence of an evolution in the learning styles of students throughout their studies. This development is strongly influenced by the learning styles of teachers. These changes reflect a statistically significant relationship between learning styles and academic performance in design work. It is assumed that learners perform better if their learning styles fit with their teachers (Hawkar Akram Awla, 2014). This approach is called “learning hypothesis” or, in its recent version, “mesh hypothesis” or “matching hypothesis” (Pashler et al, 2009), in contrary, a mismatch can leave negative impacts on learners. The learning hypothesis have been supported by several studies, the studies that showed that matching learning and teaching styles positively influenced student achievement, and related students showed a positive attitude and performed better when their teachers were responsive to their needs and preferences (Sternberg et al 1999, Peacock 2001, Naimie et al 2010, and Tuan, 2011).

4. Conclusion

The aim of this study was to examines the literature on the learning styles of architecture and interior design students in order to investigate the application of learning style theories in architecture and interior design, explore what may be related to learning styles, and explore the possibility of developing the teaching of architecture by helping teachers select the right teaching techniques.The results from the systematic review of recent literature demonstrated the importance of identifying students' learning styles, and confirm that identifying and positioning the elements of a particular learning style leads to better planning of teaching methods. Results also highlighted the link between learning styles of architecture and interior design students and the pedagogical approaches adopted, and the role of the teacher in changing student learning styles as well.

This paper reports the findings for the analysis of literature revue, which will be followed, in the future, by a longitudinal study which seeks to investigate the relationship between the learning styles of students of architecture in Algeria and their academic performance.

References

[1] Abidin, M.J.Z. Rezaee, A.A. Abdullah, H.N. Singh, K.K.B. (2011). Learning styles and overall academic achievement in a specific educational system, Int. J. Humanit. Soc. Sci. 1 (10) (2011) 143–152.

[2] Amyotte, L. et Côté, C. (2017). Complément de méthodes quantitatives. Applications à la recherche en sciences humaines (2e éd.). Montréal, QC : ERPI

[3] Carmel-Gilfilen, C. (2012). Uncovering pathways of design thinking and learning: inquiry on intellectual development and learning style preferences. Journal of Interior Design, 37(3), 47e66.

[4] Cassidy, S. (2004). Learning Styles: An overview of theory, models, and measures. Educational Psychology, 24(4), 419–444.

[5] Chen, C.J.; Toh, S.C.; Ismail, W.M.F.W.(2005). Are learning styles relevant to virtual reality? J. Res. Tech. Educ. 2005, 28, 123–141.

[6] Christou. N, Dinov, I.D. (2010). A study of students’ learning styles, discipline attitudes and knowledge acquisition in technology- enhanced probability and statistics education, MERLOT J.

Online Learn. Teach. 6 (3) (2010) 546–572.
[7] Claxton, C., & Murrell, P. (1987). learning styles: Implications for improving educational practices. Washington, DC: Clearinghouse on Higher Education, The George Washington University
[8] Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Should we be using learning styles? What research has to say to practice. London: Learning and Skills Research Centre.
[9] Demirbas O O, Demirkan H. (2003). Focus on architectural design process through learning styles. Design Studies 24 (2003) 437–456. 2003 Elsevier Science Ltd.
[10] Demirbas O O, Demirkan H (2007). Learning styles of design students and the relationship of academic performance and gender in design education. Learning and Instruction 17 (2007) 345-359. Elsevier Ltd.
[11] Demirkan, H., & Demirbas, O. O. (2008). Focus on the learning styles of freshman design students. Design Studies, 29(3), 254e266.
[12] Demirkan, H.& Demirbas, O. O.(2010) The effects of learning styles and gender on the academic performance of interior architecture students Procedia Social and Behavioral Sciences 2 pp 1390–1394
[13] Demirkan H. (2016). An inquiry into the learning-style and knowledge-building preferences of interior architecture students. Design Studies 44 (2016) 28e51. 016 Elsevier Ltd
[14] Dunn, R. & Dunn, K. (1992). Teaching elementary students through their individual learning styles. Boston: Allyn & Bacon.
[15] Dunn, R. & Dunn, K. (1993). Teaching secondary students through their individual learning styles: Practical approach for grades 7-12. Boston: Allyn and Bacon.
[16] Felder, R. M., & Silverman, L. K. (1988). Learning styles and teaching styles in engineering education. International Journal of Engineering Education, Ontario, 78(7), 674–681.
[17] Felder, R. M., & Soloman, B. A. (1991). Index of learning styles questionnaire. North Carolina State University, 1991. Disponívelem
http://www4.ncsu.edu/unity/locke%20rs/users/f/felder/public/ILSdir/styles.htm
[18] Felder, R. M.(1993). Reaching the second tier: Learning and teaching styles in college science education, J. Coll. Sci. Teaching, 23(5), 1993, pp. 286±290.
[19] Felder M R et Brent R (2005). Understanding Student Differences. Journal of Engineering Education, 94(1), 57-72 (2005)
[20] Fortin, M.-F. et Gagnon, J. (2015). Fondements et étapes du processus de recherche. Méthodes quantitatives et qualitatives (3e éd.). Montréal, QC : Chenelière Éducation.
[21] Fulani O et al. (2016). Gender, learning styles and performance of 1st year architecture students: first stage of a longitudinal study. In: EDULEARN16 Conference, 4th-6th July 2016, Barcelona, Spain.
[22] Hawkar Akram Awla. (2014). Learning Styles and Their Relation to Teaching Styles. International Journal of Language and Linguistics. Vol. 2, No. 3, 2014, pp. 241-245. doi: 10.11648/j.ijll.20140203.23
[23] Khan KS, Kunz R, Kleijnen J, Antes G. 2003. Five steps to conducting a systematic review. J Royal Soc Med. 96:118–121.
[24] Khurshid,F, Mahmood, N. (2012). Learning styles of natural sciences, social sciences and humanities students at graduate level, Interdiscip. J. Contemp. Res. Bus. 3 (9) 672–678.
[25] Kolb, D. (1984). Experiential learning. New Jersey: Prentice Hall Inc.
[26] Kolb, D. A. (1985).learning style inventory. Boston: McBer.
[27] Kolb, D. A., & Kolb, A. Y. (2013). The Kolb learning style inventory - version 4.0. A comprehensive guide to the theory, psychometrics, research on validity and educational applications.Kolb, B., & Whishaw, I. Q. (1998). Brain plasticity and behavior. Annual Review of

Technium Social Sciences Journal
Vol. 37, 88-100, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Psychology, 49(1), 43–64.
[28] Kvan Tet Yunyan J (2005). students' learning styles and their correlation with performance in architectural design studio. Design Studies 26, 2005, 19-34. Elsevier Ltd
[29] Labib W et al (2019). Learning style preferences of architecture and interior design students in Saudi Arabia: A survey. MethodsX 6 (2019) 961–967.
[30] LdPride.(n.d.),What are learning styles? Retrieved on March, 29, 2012 from http://www.ldpride.net/learningstyles.MI.htm.
[31] Mills, J., Ayre, M., Hands, D. & Carden, P. (2005). "Learning about learning styles: can it improve engineering education?", MountainRise, Vol. 2, No. 1, pp. 145-182.
[32] Mortimore, T. (2003) Dyslexia and Learning Style. A Practitioner's Handbook. London: Whurr Publishers Ltd.
[33] Mostafa, M., & Mostafa, H. (2010). How do architects think? Learning styles and architectural education. International Journal of Architectural Research, 4(2e3), 310e317.
[34] Naimie, Z., Siraj, S., Piaw, C. Y., Shagholi, R., & Abuzaid, R. A. (2010). Do you think your match is made in heaven? Teaching styles/learning styles match and mismatch revisited. Procedia Social Behavioral Sciences, 2, 349–353.
[35] Newland, P., Powell, J., & Creed, C. (1987). Understanding architectural designers' selective information handling. Design Studies, 8(1), 1e17.
[36] Nussbaumer L (2000). The Relationship Between Learning Styles and Visualization Skills Among Interior Design Students. Interior Design Educators Council, Journal of lnterior Design 26(1), 1-15
[37] Nussbaumer, L. L. (2001). Theoretical framework for instruction that accommodates all learning styles. Journal of Interior Design, 27(2), 35-45.
[38] Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009) Learning styles: Concepts and evidence. Psychological Science in the Public Interest, 9(3), 105-119.
[39] Peacock, M. (2001) Match or mismatch? Learning styles and teaching styles in EFL. International Journal of Applied Linguistics, 11(1), 1-20.
[40] Sternberg, R.J., Grigorenko, E.L., Ferrari, M., & Clinkenbeard, P.(1999) A triarchic analysis of an aptitude– treatment interaction. European Journal of Psychological Assessment, 15, 1–11.
[41] Tezel, E et Casakin H (2010). LEARNING STYLES AND STUDENTS' PERFORMANCE IN DESIGN PROBLEM SOLVING. Archnet-IJAR, International Journal of Architectural Research - Volume 4 - Issues 2-3 - July and November 2010
[42] Tuan, L. T. (2011). Matching and stretching learners' learning styles. Journal of Language Teaching and Research, 2(2), 285–294.
[43] Tucker, R. (2007). Southern drift: the learning styles of first-and third-year students of the built environment. Architectural Science Review, 50(3), 246e255.
[44] Tucker, R. (2008) Learning Style Drift: Correlation between Built Environment Students' Learning Styles and the Learning Styles of their Teachers, Journal for Education in the Built Environment, 3:1, 68-79
[45] Tucker, R. (2009) Getting old and heading south: the academic success of Southerner learners in design cohorts, Higher Education Research & Development, 28:2, 195-207.