

Towards Sustainable Nigerian Architectural Education: The Relationship Between Design Education, Learning Styles and Personality Types Among Architecture Students

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Abstract

Architectural education comes from a long tradition of technical and artistic apprenticeship which is evolving in Nigeria and around the world. The aim of this study is to examine the relationship between design education (what), learning styles (how) and personality types (who) in a bid to develop sustainable, inclusive teaching strategies for the 21st century and beyond. The quantitative study assessed the preferred learning styles and predisposition for the five genetic personality traits in students of Architecture at the University of Jos, and juxtaposed the findings against their performance in design studio. The study findings showed that Accommodators and Divergers who were the highest performers in design studio were also the more likely to exhibit openness and conscientiousness. Convergers were more willing to accept criticism from their mentors and peers, and Assimilators were more prone to neurosis displayed as fear of disappointment and anxiety when they performed lower than their contemporaries. The study findings encourage continued monitoring of evolving teaching and learning styles, as well as cognisance of student distinctive personality types to guide educators on developing teaching modules and methods that will be enduring and effective for holistic architectural education.

Keywords: Design Education, Learning Styles, Personality Types, Sustainable Education.

Introduction

Throughout history, education has always needed to evolve in order to remain relevant to its stakeholders. This means that foundational principles require contextualisation and constant reviews in order to bridge the gaps that develop as man's needs, wants and aspirations also evolve. Architectural education is on a precipice. From a long tradition of being simply a response to one of mankind's basic needs – which is to provide housing or shelter – Architecture has progressed into becoming a driver of one of the greatest catalysts of change in the world we now live in (Rodic, Zivkovic & Lalović, 2013; Yuping & Shuang, 2017). From global warming caused by high energy consumption and harmful global carbon dioxide emissions, to housing shortages and non-sustainable building practices and costs, the list of demands placed upon architects to respond with workable solutions has never been greater. Several studies have examined the role of architectural education to prepare fully-equipped professionals for the arduous task with mixed reviews. Architectural education has been labelled "outdated" and "inadequate" (Olotuah, 2006; Karamaz & Ast, 2017), "[insufficient] from the dearth of teaching resources and facilities in the schools", and devoid of any "objectives and philosophies" to guide schools through the training period (Maina, 2008).

Inclusive architectural education is borne of a combination of soft skill and hard skill development. In the face of looming automation of most architectural hard skills through the use of Artificial

Intelligence (AI), the attention of most architectural educators has shifted to the development of soft architectural skills, which to a large extent, cannot be easily replicated or replaced with machines (Akande, Olagunju & Ayuba, 2006; Maina & Salihu, 2016; Ioannou, 2018). Many researchers agree that the use of computers and other mechanised tools of the design process is integral to repositioning the role of the architect to present-day design responses. Architects should be capable of thinking without the use of technology but do so faster and more efficiently where they exist (Deutsch, 2020). This has led this study to pay increased attention on pedagogy and psychology in design education to promote the much-needed critical and creative thinking the architectural profession requires to survive and thrive.

Research Questions

For contextual analysis, the study considers some of the following research questions:

1. What are the identifiable learning styles and personality types exhibited by selected Nigerian architecture students?
2. In what ways does design education output reflect the impact of learning styles and personality types among selected Nigerian students outside of neuromyths?
3. How can design education be repositioned to benefit from an enhanced pedagogy based on the understanding of the understanding of preferred learning styles and personality types?

Aim and Objectives of the Study

This study takes a look at what is being taught in Nigerian schools of architecture alongside the emerging issues surrounding design teaching and learning styles associated with the different personality of student architects. This is intended to serve as an impetus for constant review of the architectural design education programme in line with global expectations and a response to the changing socio-economic situation in African countries. In order to achieve the stated research aim, the study maintains the following research objectives:

- To identify the preferred learning styles and personality types among selected Nigerian students of Architecture;
- To highlight the impact of learning styles and personality type on design education output in Nigerian schools of Architecture, and;
- To corroborate leanings indicating that design education would benefit from enhanced pedagogy with bearings from individual learning styles and personality types.

The study uses quantitative and qualitative data to offer insight into primary and secondary sources of information on design education curriculum, learning styles and student personality types, from which recommendations on effective architectural educational practices will be made.

Literature Review

Design education is geared towards identifying and developing design ability from novicehood to a level of expertise or advanced competence (Dizdar, 2015). Curriculum or programmes of study in schools of design are tailored to specific ideologies which nurture schools of thought amongst the participants. Architectural education draws from a transdisciplinary background of both the sciences and the arts which includes instruction in arts and drawing, historical and theoretical studies, building systems and technology, humanities and social studies, environmental control studies and the physical sciences (Ibrahim & Utaberta, 2012; Huang, Hui & Sarmiento, 2022). Traditional schools of

architecture incorporate each of these modules over the course of undergraduate and (or) postgraduate study at select durations and emphasis. Documentation of architectural education history dates back to the writings of the Roman architect/engineer Vitruvius (80s BC – 15 BC) who kept records of Architecture activities and was credited with the earliest known annals of Architecture education. His work inspired the writing of Leon Battista Alberti, Walter Gropius (of the famous Bauhaus School of Architecture), and other proponents of the Académie d'Architecture and the Ecole des Beaux-Arts (Sinal, 2016).

The findings from a recent review of the undergraduate curriculum in schools of architecture in different countries, including Nigeria, shows that all the prescribed modules for holistic architectural education are included (Enwerekwe & Chong, 2023). Given the complexities of critical and design thinking in architectural education, there exists considerable appreciation of the inclusion of courses on design theory in modern architectural curriculum in some Nigerian schools of architecture, particularly alongside practical courses on design studio where the theoretical knowledge is applied. Previous studies (Uluöglu, 2000; Tezel & Caskin, 2010; Almendra, 2012; Aderonmu, 2013; Crowther, 2013; Eshun, 2016; Enwerekwe & Dassah, 2021) have already established several links between design theory and design competence exhibited in the studio.

The mere presence of a curriculum which supports adequate design theory and practice is however, insufficient without the right pedagogy. Updated architectural education is expected to address concerns about the different learning styles of its participants and the idiosyncrasies thereof. Learning and designing can be thought of as the same basic process of adaptation viewed from different perspectives. The design studio is a core subject in architectural education, all other supporting architectural courses provide contributions towards design learning. In the course of designing, the designer is learning about the problem, the solution, and relationships between them (Demirbas & Demirkan, 2003; Cross, 2011). The design studio is a physical as well as social space whose sole purpose is to investigate design through informal modes of exchanging insights, developing communicative abilities as well as their problem-solving skills and shaping sensitivities of students (Cikis & Cil, 2009). For this reason, the studio experience for architecture students can be likened to an apprentice workshop. This is the testing ground for the student to demonstrate control and command over his or her creative skill. With few analytical exceptions, many researchers and educational philosophers agree there are several ways of learning: that is to say that individuals differ in their preferred way of assimilating, gathering and remembering information, particularly in our technologically-driven society (Cabual, 2021). Many different aspects of learning styles have been examined and several theories and multiple models have been postulated to describe how people think and learn; among them are the Dunn and Dunn Model, the VARK Model, Felder-Silverman Model and Kolb's Experiential Learning Theory (Kolb, 1984; Pashler et al., 2009; Xing, 2023).

Kolb's Experiential Learning Theory (ELT) has the greatest bearing on design learning as it uses the Learning Style Inventory (LSI) to help determine the learning preference of an individual based on innate characteristics and past experiences. From these foundations, Kolb has developed a learning theory in which learning is modelled as a four-staged cycle comprised of Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualisation (AC), and Active Experimentation (AE). The ELT portrays two bipolar dimensions from the four stages in the learning cycle namely the perceiving (vertical axis) and the processing (horizontal axis). It suggests that the CE dimension is dialectically opposed to AC, and likewise RO to AE. From their life experience and innate characteristics, individuals will develop preferences for one or two particular phases of the four-learning cycle (Figure 1). Therefore, a combination of scores on the two dimensions classifies learners into one of four

learning styles namely: Accommodating (CE and AE), Diverging (CE and RO), Converging (AC and AE) and Assimilating (AC and RO).

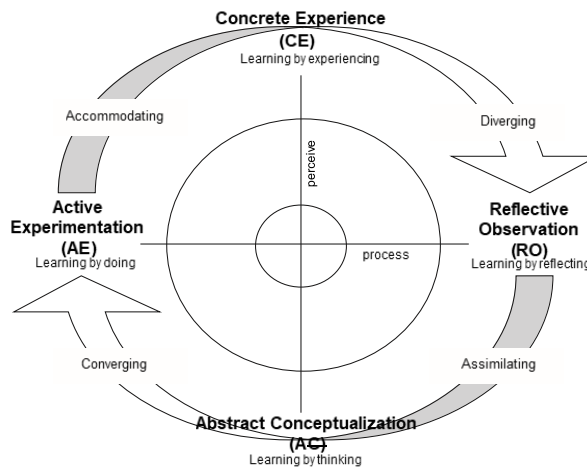


Figure 1: Four learning phases of Experiential Learning Theory

Source: Kolb, 1984

A study in China found biased correlation between the academic success of students with different learning styles; the research concluded that students who were convergers were less fruitful in the architectural design studios than assimilators (Kvan & Jia, 2005). In another study, Demirbas and Demirkan (2007) examined learning styles and their relationships with gender and scores related to four artistic, technical, basic and design courses and the grade point averages of new students over three consecutive semesters. In this study, the students convergent and assimilating learning styles were the students' preferences. No significant difference was found between gender and learning styles although male students outperform female students in technical courses. Significant difference was found in students' design scores with divergent and convergent learning styles. Some other studies support this view by further stating that there is insufficient scientific-based evidence that learning styles affects academic performance, resulting in the advocacy of other practices such as active learning and culturally responsive teaching to improve student performance (Newton & Salvi, 2020; Thomas, 2021; Whitman, 2023).

In a study in Nigeria, the design students learning styles were measured in the first and final years of their education by using the experimental model of Kolb's learning style (Akinyode & Khan, 2016). The results indicated that first year design students were more closely associated with diverging (44%) and assimilating (32%) learning styles, respectively. In addition, the prevailing styles of students in the final year of the study were diverging (50%) and assimilating (24%) respectively. A recent study on the learning styles of students in the University of Jos found that the distribution was greater in the diverging learning style and converging learning styles which contradict previous research findings which showed that architectural students tend to fall within the accommodating and assimilating learning styles (Dassah et al, 2018). Emerging studies seek to establish that design studio learning can encompass a wide range of styles and a link exists between learning styles of students and their performance in design studio. The study showed that most students in the sample were Assimilators and Convergers, however, Accommodators were better performers in the design studio (Enwerekwe, Adetula & Chong, 2023).

Holistic research into design teaching and learning cannot exclude the relationship between design education and psychology, which is the science of the mind and personality. Personality refers to

aspects of individual behaviour, attitude, beliefs, thoughts, actions and feelings typical of the individual which set them apart from others (Sadeghi et. al, 2012). Psychologists use personality type theories to classify people by personality type. While personality traits are non-contextual factors which come in different levels or degrees, most behaviourists agree that a singular act is not regarded as one's personality. Rather continuous behaviour and other characteristics of an individual affecting his or her actions consistently is that person's personality. Personality type affects the way people respond to stimuli and the way that they prefer to learn (Schaubhut, Herk & Thompson. 2009).

Establishing the reasons for a personality trait is not easy because they are very diverse. Most causation theories on personality discourse suggest genetics plays a significant role: the biology on genotypes remains arguably the strongest science behind why an individual respond to social encounters in a particular way (McCrae, 2002; Kumaranayake, 2017). The other factor that causes personality traits is environment although most researchers would agree that environmental influences are not nearly as strong as genes. There are five personality traits that are influenced by genetics, which are: *openness*, *conscientiousness*, *extroversion*, *agreeableness*, and *neuroticism*. Personality types are formed by the combination of these factors in varying degrees (Cherry, 2023). Personality assessment is conducted by a variety of tests including the Five Factor Personality Model, the Personality Style Indicator, the Rorschach Inkblot Test, the Winslow Personality Profile, the Myers-Briggs Type Indicator, and many more. Stein and Swan (2019) posited that the Myers-Briggs Type Indicator (MBTI) model currently is the most accepted, widespread and popular test for measuring personality. The MBTI model identifies sixteen types, namely ISTJ, ISFJ, INFJ, INTJ, ISTP, ISFP, INFP, INTP, ESTP, ESFP, ENFP, ENTP, ESTJ, ESFJ, ENFJ, and ENTJ. These personality types are derived from four opposite pairs or "dichotomies" shown below in Figure 2. Most psychological evaluations opine the INTP is the most compatible personality type for architects.

Dichotomies

Extraversion (E) – (I) Introversion

Sensing (S) – (N) Intuition

Thinking (T) – (F) Feeling

Judging (J) – (P) Perception

(*note: the terms used for dichotomies have specific technical meaning to the MBTI which differ from their everyday usage).

Figure 2: Four pairs of dichotomies for the MBTI test

Source: Myers and Myers (1980, 1995)

Methodology

The study adopts a quantitative approach to collect, process and analyse numerical data. The design is appropriate for the study because of the intention to generate knowledge and create understanding about the relationship between architectural education, learning styles and personality types (Bhandari, 2022). The study relies on primary data sourced from the Department of Architecture, University of Jos for its analysis on quantifiable objectives and emphasis on statistical techniques (Ahuja, 2010). A purposive random sample of 25 second year undergraduates were administered the questionnaires containing a Kolb's Learning Style Inventory (LSI) test, of which 19 were returned correctly completed and used for analysis. 25 fourth year undergraduates were

administered the questionnaires, of which 22 were valid. This represents a response rate of 82% which fulfils statistical requirements for a valid survey. The same sample was subsequently administered an MBTI-style self-report multiple choice questionnaire to determine their dominant personality traits and dichotomies. The findings were presented and discussed with a descriptive analysis design in order to draw logical deductions towards the study aim. The students' learning style is analysed against a graded design studio performance between A to F. The study findings are presented using simple percentages, tables, graphical descriptions (graphs and charts), and descriptive statistical methods.

Data Presentation and Discussion

The study sample comprised of 32 male students (14 in the second year and 18 in the fourth year) representing 78% of the total sample. With 9 female students in the sample (5 in the second year and 4 in the fourth year), the female students made up 22%. All the students in the sample were between 18-29 years old, however the majority of the second-year students (73.7%) were between 18-21 years old and majority of the fourth-year students (50%) were between 22-25 years old. The discussions of the results centre around the relationship between design education, learning styles and personality types.

1. Learning styles

The deductions made from the combination of scores on the two dimensions, (AC-CE) and (AE-RO) then classifies learners into one of four learning styles namely Accommodating (CE and AE), Diverging (CE and RO), Converging (AC and AE) and Assimilating (AC and RO) as given on Table 1.

Table 1

Overall distribution of learning styles of students in the sample

Learning style	Second year	Percent (%)	Fourth year	Percent (%)	Total	Average Percent (%)
Divergers	3	15.8	2	9.0	5	12.2
Accommodators	4	21.1	4	18.1	8	19.5
Convergers	5	26.3	7	31.8	12	29.3
Assimilators	7	36.8	9	40.9	16	39.0

Source: Adetula (2021)

The results showed that among the students sampled, the distribution showed a higher proportion of assimilating (36.8%, 40.9%) and converging (26.3%, 31.8%) learners. Among assimilating learners, the dominant learning preferences are learning by observation (RO) and learning by experiencing (CE), while converging learners tend to prefer learning by thinking (AC) and learning by doing (AE). The cross-referenced analysis of the student preferred learning style with their performance in design studio programmes utilised records obtained from a public scoring system during a jury (or crit) of the sampled students from the same academic session. The weighted scoring system used during the jury exercise assessed the student concept formulation techniques, functional requirements, presentation techniques and oral presentation skills, the results of which are given on Table 2.

Table 2

Overall grade distribution of students in the sample

Grade Score	Second year	Percent (%)	Fourth year	Percent (%)
A	1	5.3	-	-
B	4	21.0	4	18.2
C	8	42.1	7	31.8
D	6	31.6	10	45.4
F	-	-	1	4.6
Total	19	100.0	22	100.0

Source: Adetula (2021)

An ordinal scale divided into 5 ranges was used to assess the student design submissions. Scores were assessed according to the following ranges: A (70-100); B (60-69); C (50-59); D (40-49); F (0-39).

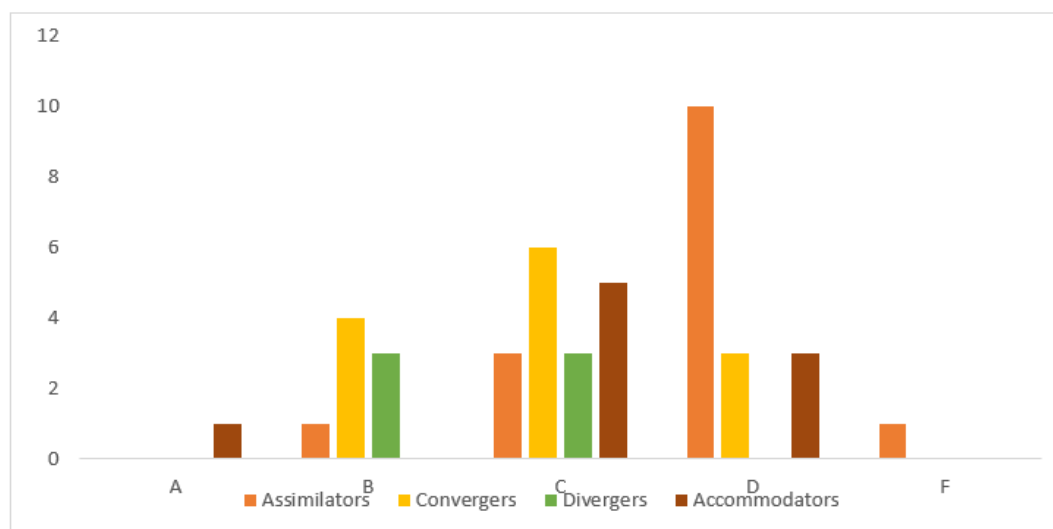


Figure 3: Grade distribution by design studio learning style in both second- and fourth-year students (Source: Adetula, 2021).

Figure 3 shows the uneven distribution of grades amongst the four learning styles. During the terminal jury exercise, Assimilators who constitute 39% of the population, were found to receive proportionally larger C- and D-grades than other learning styles. All the bottom performers in the jury were also Assimilators. Convergers who constitute 29.3% of the sample, receive larger proportions of B-, C- and D-grades in comparison to Divergers (12.2%) who were mid-level performers with B- and C-grades. In this study, Accommodators who constitute 19.5% of the sample observed were the only group to receive an A-grade but of note, were observed to receive C- and D-grades, featuring as both top- and mid-performing students in the jury exercise. The study showed that most students in the sample were Assimilators and Convergers, however, Accommodators were better performers in the design studio.

2. Personality types

Understanding how students deal with the high-stress culture in architectural education and deal positively with potential stressors will help to employ proactive teaching styles and devise educational material that will benefit all students. Understanding what institutional and programmatic experiences students see as crucial to their mental health will enable educators focus on more inclusive teaching practices and mindful advising standards. This section of the study examined the five genetic personality traits of the student sample to gain further insight into their

personalities. Figures 4-8 show the student perception on their predisposition to each of the five genetic personality traits, ranking on a weighted scale of 1 to 5 (1 is very low, 2 is low, 3 is average, 4 is high, and 5 is very high). The results were cross-referenced with the classifications based on their preferred learning styles.

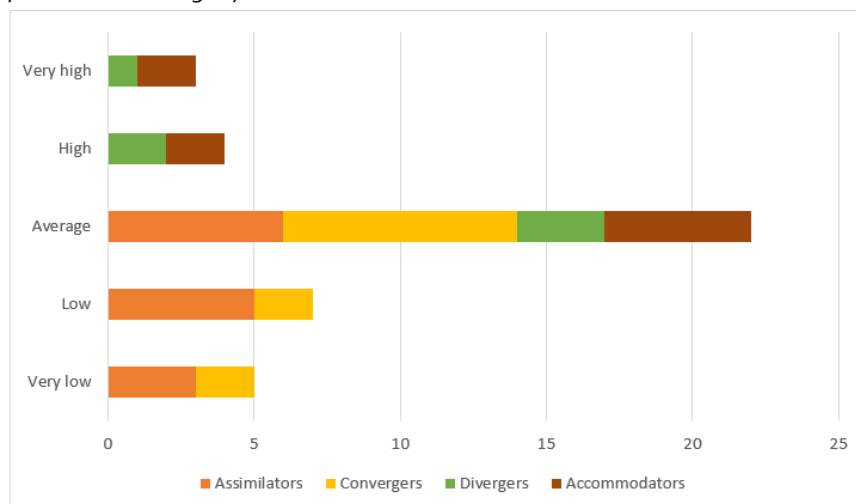


Figure 4: Student perception on openness (Doyle, 2021)

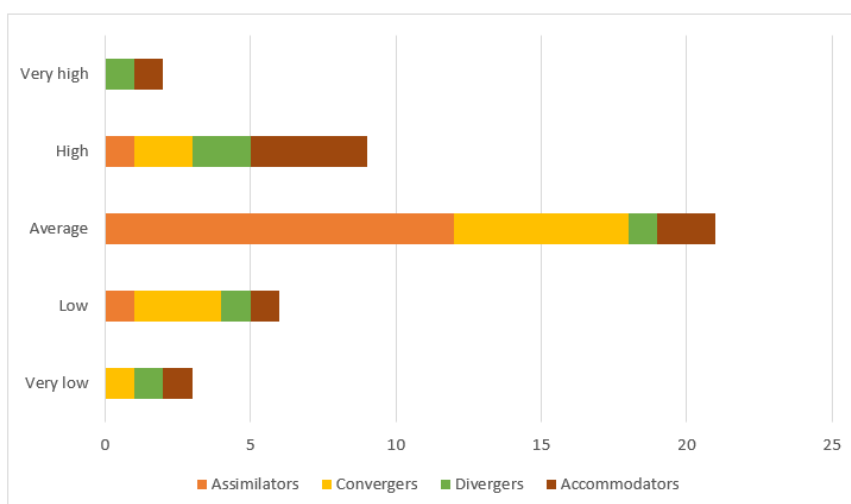


Figure 5: Student perception on conscientiousness (Doyle, 2021)

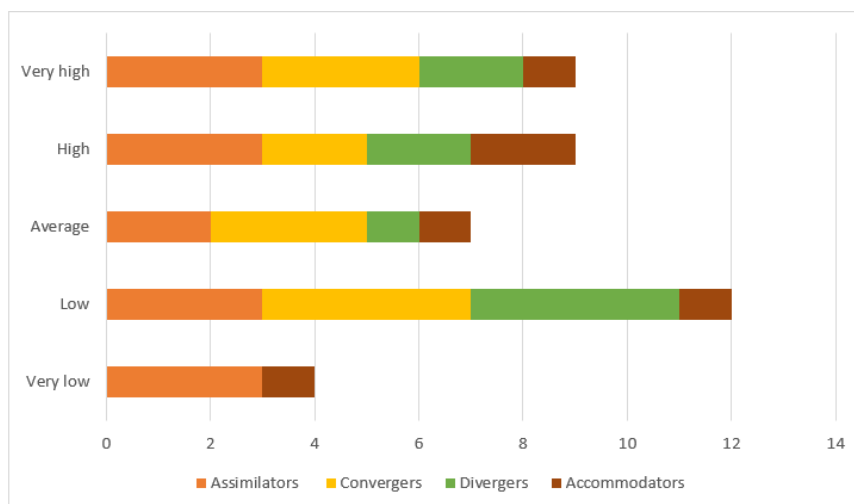


Figure 6: Student perception on extraversion (Doyle, 2021)

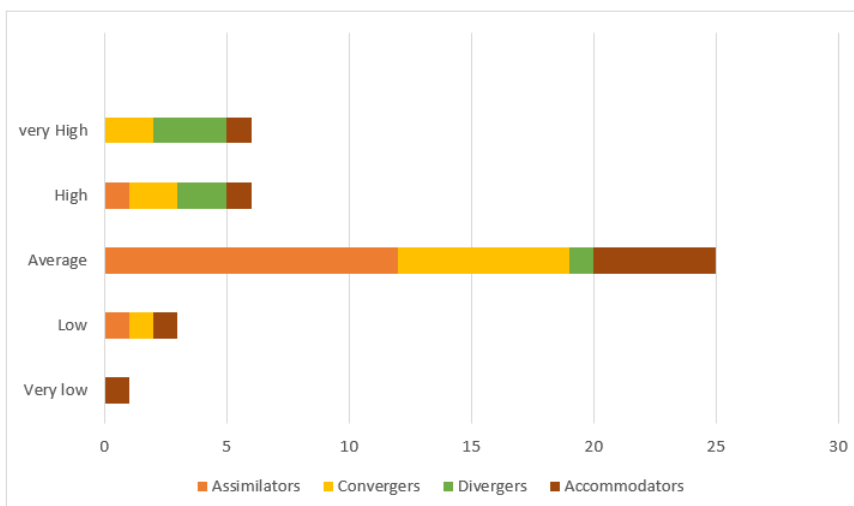


Figure 7: Student assessment on agreeableness (Doyle, 2021)

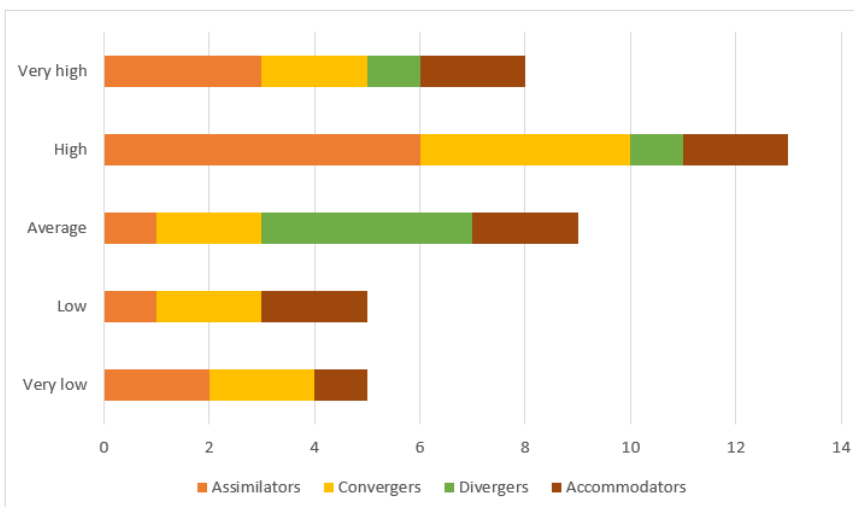


Figure 8: Student assessment on neuroticism (Doyle, 2021)

Openness implies a willingness to form unbiased, broad-minded, observant or impartial opinions or perspectives. The study observed that more than two-thirds (70.7%) of the students indicated they were open to trying new things or seeing things from different perspectives. The students who expressed "high" or "very high" degrees of openness were observed to be accommodator or diverger learners. Those who were less likely to be receptive to new ideas were assimilators and convergers (Figure 4). 53.7% of the students who comprised all classifications of learners opined they were "averagely" open to new ideas. This suggested that many students in the sample were reluctant to try new things if they did not necessarily need to. Conscientiousness refers to being thorough or careful with tasks. The study findings were unevenly distributed among the learners although 51.2% of the respondents claimed their level of conscientiousness was "average". 55.5% of accommodators believed their conscientious levels were "high" or "very high", suggesting that they were proportionally more disposed to meticulousness than other learners (Figure 5). Extraversion (or extroversion) is seen in the way an individual socialises with others with respect to meeting and interacting with people easily and comfortably. Architecture students often integrate with their peers and mentors during periods of extended design studio activity peculiar to the structure of architectural education. The study findings show a highly uneven distribution of extraversion among the learners (Figure 6) with over 56% of the students admitting to having "very low" to "average" levels of extraversion. As a result, students tend to shy away from in-person social interaction during design studio sessions and prefer to work in isolation – away from the studio spaces – or in intimate cluster groups dictated by gender or specific affinity. This tendency seems to corroborate findings in related studies on studio culture in schools of architecture (Enwerekwe, 2018).

A person's tendency to be in harmony about an opinion, statement or consistent idea with other people is what is termed agreeableness. In design education, students may demonstrate they are agreeable when they accept criticism from their peers and mentors without being incongruous or discordant. From the sample observed, divergers were the most agreeable learners (Figure 7) while 66.7% of the convergers and 92.9% of the assimilators implied they had "average" to "low" levels of agreeableness. Accommodators showed an almost-even distribution of agreeableness across the range. Although regarded in most medical circles as a form of a mental disorder, neurosis in more practical everyday circles exists as a mild sense of anxiety or fear to unfamiliar conditions or situations which require change. 73.1% of the students sampled said they nursed "average" to "very high" concerns or worries about their performance and outcome in design studio exercises. 64.3% of the assimilators and 50% of the convergers expressed "high" to "very high" neurosis over their submission requirements and earned grades in design studio exercises.

Conclusion

At the end of the study, the findings highlighted the importance of a holistic curriculum in Nigerian schools of Architecture which should include robust training in practical design courses and courses on design theory. The study showed that student architects perform differently in architectural programmes based on their learning styles and personality type. In the study sample, majority of the students were assimilators or convergers, however, accommodators were the best performing students in practical design studio. The study also identified personality traits among design students which may affect their genetic predisposition towards learning. The study findings show that accommodators and divergers are more open to trying new things and are more conscientious. Accommodators are also more inclined to be agreeable. Assimilators display more neurosis and tend

to be more extroverted. Convergers are even-tempered and less prone to arguing with opposing views from their mentors and/or peers.

Understanding the relationship between design education (the “what”), learning styles (the “how”) and personality types (the “who”) is imperative for preserving the future of architectural education. Students and mentors should consider understanding the impact learning styles and personality types have on design education in order to better improve inclusive teaching and learning practices. Several updated researches decries the adoption of teaching methods based on learning styles accusing the practice of “bottle-necking” or “pigeon-holing” to learn in a particular way rather than motivating them to learn holistically. However, visual subjects under apprenticeship models such as architecture have shown significant quantitative and qualitative evidence in this study that design output is indeed affected by learning styles and personality types.

Recommendations

The following recommendations therefore arise from the study:

- To better interpret the implications of these results, larger and more diverse student samples would support wider discussions concerning learning styles and personality types in architectural pedagogy and curriculum development by policy makers, educational regulators and professional bodies.
- Despite divergent views about the efficacy of adopting learning styles to teaching practice and development, this study advocates updated empirical research into the subject matter to provide evidence-based research which can impact the enhancement of design education. These studies are not only necessary but must be carried out properly in order to contribute meaningfully to the ongoing discourse.
- The study also recommends that architectural education in Nigeria becomes familiar with the concepts of *learning preferences* and *learning matching*, both of which are often used interchangeably, but represent distinct approaches for improved academic output. This disparity will form the basis for additional research into the theories already discussed in this study.

References

- Aderonmu, A. P. (2013). The design studio in selected schools of architecture in south-west Nigeria: A study of pedagogy, culture and environment. (Unpublished doctoral thesis), Covenant University, Ota, Ogun State, Nigeria.
- Adetula, I. A. (2021). The effect of students learning styles on performance in architectural design studio. (Unpublished baccalaureate thesis), University of Jos, Plateau State, Nigeria.
- Ahuja, R. (2010). Research Methodology. Rawat Publication.
- Akande, O. K., Olagunju, R. E. & Ayuba, P. (2006). Academic excellence in architectural education and opportunities and challenges for the architect graduate. AARCHES-J, 5(1), 40-47.
- Akinyode, B. F., & Khan, T. H. (2016). Students learning style among planning students in Nigeria using Kolb’s learning style inventory. Indian Journal of Science and Technology, 9(47), 1-13.
- Almendra, R. (2012). Educating critical thinking in design research. International Conference on Engineering and Product Design Education, Artesis University College, Antwerp, Belgium, 6-7 September.
- Bhandari, P. (2022, November 24). What Is Quantitative Research? Definition, Uses & Methods. Scribbr. Retrieved May 9, 2023, from <https://www.scribbr.com/methodology/quantitative-research/>
- Cabual, R. A. (2021). Learning styles and preferred learning modalities in the new normal. Open Access Library Journal, 8, 1-14. <https://doi.org/10.4236/oalib.1107305>.
- Cherry, K. (2023, March 1). Is personality genetic? Very Well Mind [Web log post]. Retrieved from <https://www.verywellmind.com/are-personality-traits-caused-by-genes-or-environment-4120707>

- Cikis, S., & Cil, E. (2009). Problematisation of assessment in the architectural design education: first year as a case study. *Procedia Social and Behavioural Sciences*, 1(1), 2103-2110.
- Cross, N. (2011). *Design Thinking*. London: Bloomsbury Academic.
- Crowther, P. (2013). Understanding the signature pedagogy of the design studio and the opportunities for its technological enhancement. *Journal of Learning Design*, 6(3), 18-28.
- Dassah, E. T., Nimlyat, P. S., Gaiya, N. S., Gofwen, C. N., Ola-Adisa, E. O. (2018). Developing appropriate teaching and communication methods in architectural design studio through understanding students' learning styles. *Journal of Scientific and Engineering Research*, 5(6), 360-366.
- Demirbas, O. O., & Demirkan, H. (2003). Focus on architectural design process through learning styles. *Design Studies*, 24, 437-456.
- 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(3), 345-359.
- Deutsch, R. (2020). *Think like an architect: How to develop critical, creative and collaborative problem-solving skill*. London: RIBA Publishing.
- Dizdar, S. I. (2015). Architectural Education, Project Design Course and Education Process Using Examples. *Procedia – Social and Behavioural Sciences*, 176, 276-283. <https://doi.org/10.1016/j.sbspro.2015.01.472>.
- Doyle, J. (2021). The effect of personality types on the design process of architecture students at the University of Jos. (Unpublished baccalaureate thesis), University of Jos, Plateau State, Nigeria.
- Enwerekowe, E. O. (2018). Attitudes towards design studio culture and the expected learning outcomes in Nigerian schools of Architecture. In Azare, G., Arokoyo, S. B. & Amough, C. K. (Eds.), *Reforms and Innovation in Nigerian Education: The Journey so Far* (pp. 1-14). Onitsha: West and Solomon Publishing Co.
- Enwerekowe, E. O., Adetula, I. A. & Chong, J. D. (2023). The effect of students learning styles on performance in architectural design studio (A study in Jos, Nigeria). *Journal of Education and Policy Review*, 15(1), 12-31.
- Enwerekowe, E. O. & Chong, J. D. (2023). Understanding design concept utilisation among architecture students towards project execution self-satisfaction: A study in Jos. *International Journal of Research Findings in Engineering, Science and Technology*, 5(1), 1-16. <https://doi.org/10.48028/iiprds/ijrfest.v5.i1.01>.
- Enwerekowe, E. O. & Dassah, E. T. (2021). Perceptions about the Role of Problem Specifications in Design Learning and Studio Assessment: A Study in Jos, North-Central Nigeria. *European Modern Studies Journal*, 5(3), 365-378.
- Eshun, E. F. (2016). Graphic design students' perspectives and attitudes towards feedback within peer assessment in design studio pedagogy. *International Journal for Innovation, Education and Research*, 4(6), 22-33.
- Huang, A., Hui, V. & Sarmiento, K. (2022). Architectural pedagogy: Towards professional practice. Paper presented at the 14th International Conference on Education and New Learning Technologies, Palma, Spain, July 4-6.
- Ibrahim, N., & Utaberta, N. (2012). Learning in Architecture Design Studio. *Procedia – Social and Behavioural Sciences*, 60, 30-35. <http://dx.doi.org/10.1016/j.sbspro.2012.09.342>.
- Ioannou, O. (2018). Opening up design studio education using blended and networked formats. *International Journal of Educational Technology in Higher Education*, 15(47), 1-16. <https://doi.org/10.1186/s41239-018-0129-7>.
- Karmaz, Ö. & Ast, R. (2017). A research on the current problematics and possible solutions of architectural design education. Paper presented at the DAKAM Educational Studies 17 International Conference on Education and Learning, Istanbul, Turkey, April 21-22.

- Kumaranayake A. R. (2017). Review of the current status of the studies on personality traits. *International Journal of Applied Research*, 3(11), 38-45.
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs: Prentice-Hall.
- Kvan, T., & Jia, Y. (2005). Students learning styles and their correlation with performance in architectural design studio. *Design Studies*, 26(1), 19-34.
- Maina, J. J. (2008). *Architecture education in Nigeria: Problems and way forward*. Ph.D. seminar presentation, Department of Architecture, Ahmadu Bello University, Zaria-Nigeria, May.
- Maina, J. J. & Salihu, M. M. (2016). An assessment of generic skills and competencies of architecture graduates in Nigeria. *ATBU Journal of Environmental Technology*, 9(1), 30-41.
- McCrae, R. R. (2002). Cross-Cultural Research on the Five-Factor Model of Personality. *Online Readings in Psychology and Culture*, 4(4), 1-12. <http://dx.doi.org/10.9707/2307-0919.1038>
- Myers, I. B. & Myers P. B. (1980, 1995). *Gifts differing: Understanding personality types*. Mountain View, CA, USA: Davies-Black Publishing.
- Newton. P. M. & Salvi, A. (2020). How common is belief in the learning styles neuromyth, and does it matter? A pragmatic systematic review. *Frontiers of Education*, 5. <https://doi.org/10.3389/feduc.2020.602451>.
- Olotuah, A. O. (2006). At The Crossroads of Architectural Education in Nigeria. *CEBE Transactions*, 3(2), 80-88.
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning styles: concepts and evidence. *Psychological Science in the Public Interest*, 9(3), 105-119.
- Rodic, D. M., Zivkovic, J. & Lalović, K. (2013). Changing architectural education for reaching a sustainable future: A contribution to the discussion. *Spatium*, 29, 75-80. <https://doi.org/10.2298/SPAT1329075M>.
- Sadeghi, N., Kasim, Z. M., Tan, B. H. & Abdullah, F. S. (2012). Learning styles, personality types reading comprehension performance. *English Language Teaching*, 5(4), 116-123.
- Schaubhut, N. A., Herk, N. A. & Thompson, R. C. (2009). *MBTI Form M Manual Supplement*. London: Consulting Psychology Press.
- Stein R. & Swan, A. B. (2019). Evaluating the validity of Myers-Briggs Type Indicator theory: A teaching tool and window into intuitive psychology. *Journal of Social and Personality Psychology Compass*, 13(2), e12434. <https://doi.org/10.1111/spc3.12434>
- Sinhal, S. (2016). Architecture education – then and now. *International Journal of Research in Civil Engineering, Architecture & Design*, 4(1), 25-29.
- Tezel, E. & Casakin, H. (2010). Learning styles and students' performance in design problem solving. *International Journal of Architectural Research*, 4(2/3), 262-277.
- Thomas, K. (2021, January 6). New review says ineffective "learning style" theory persists in education around the world. Swansea University [Web Log Post]. Retrieved from <https://www.swansea.ac.uk/press-office/news-events/news/2021/01/new-review-says-ineffective-learning-styles-theory-persists-in-education-around-the-world.php>.
- Uluöglu, B. (2000). Design knowledge communicated in studio critique. *Design Studies*, 21(1), 33-58.
- Whitman, G. (2023). Learning styles: Lack of research-based evidence. *A Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 96(2), 1-5. <https://doi.org/10.1080/00098655.2023.2203891>.
- Xing, B. (2023). A review of research on learning style. *Open Journal of Modern Linguistics*, 13, 263-275. <https://doi.org/10.4236/ojml.2023.132016>.
- Yuping, C. & Shuang, L. (2017). Research on the reform of the preliminary course of architectural design based on innovation and practice ability training. *International Education Studies*, 10(7), 103-107. <https://doi.org/10.5539/ies.v10n7p103>.