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The Effect of Students Learning Styles on Performance in Architectural Design Studio (A study in Jos, Nigeria)

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ABSTRACT
The curriculum and programs of architectural schools and studios are often written to address theoretical and professional concerns without addressing the ways in which a particular program may be compatible with individual student learning styles. This study takes a closer look at the effect of learning styles on student performance in architectural design studio as concerns for student output in design continues to question how students learn and how their ways of learning differ from one another. The study identifies and seeks to understand learning styles and preferences of second- and fourth-year Architecture students in the University of Jos, Plateau state; and to ascertain how awareness of this various learning styles can improve the communication between instructors and design students in design studio on the basis of the Kolb's Learning Style Theory. In this study, a quantitative research approach was employed. The research instrument that was employed is the Kolb's Learning Style Inventory (LSI). Data captured in this study was analysed through descriptive statistical methods for the purpose of showing the means and spreading of students learning style preferences in each sample using tabulated descriptions and graphical descriptions. The study ascertained that the preferred learning style of a student can determine how well he/she performs in design studio. It also concluded that there are significant differences between performances of students of every pair of learning styles. The results of this study strongly suggest that recognising the association between learning styles and performance in design studio will lead to both more perceptive teaching and also more responsive learning.
Key words: architectural education, design studio behaviour, learning styles

INTRODUCTION
The design studio is a vital component of the architecture curriculum. It facilitates the teaching of various architectural disciplines through the participation of students. The design studio is the primary vehicle for teaching architectural design. Students produce diverse works in

analogue and digital media (sketches, CAD drawings, conceptual and scale models, and written work) communicate with one another and receive comments from the tutor (Ilozor, 2006). During a design project, the student transforms a field of inquiry into a proposition or scheme. The learning process is characterised by continual dialogue. Students learn from sharing information with one another and instructors, and from the critiques of the jury members. The most important learning experience comes from what is known in other disciplines as self-reflection, a skill central to the acquisition of all design knowledge and skills, and one that is consciously developed (Demirbas & Demirkan, 2003). It is believed that learning styles are more concerned with how people learn than what they learn and it is also an important factor for students' academic achievement and attitudes. Students have different strengths and preferences in the ways how they take in and process information which is to say, they have different learning styles.

For all this prominence, we still do not understand much that happens in design studio learning and research into learning processes in the studio is an area of rewarding research. The curriculum of contemporary design education is studied under fundamental courses that provide the basic knowledge necessary for the formation of design. There are also technology-based courses which provide the scientific basis for the formation of design. There are artistic courses which strengthen the base of expression and the presentation techniques related to design. Finally, there are design studio courses, which are a synthesis of the previous three categories (Demirbas, 2001; Uluöglu, 2000). Design studio courses constitute the most important part of design education.

The bulk of educational theories proposed so far have classified learners into different learning styles but few have been applied to architectural studio teaching and learning. In the area of professional education, Kolb's (1984) Experiential Learning Theory (ELT) has been widely used to explore the learning styles of undergraduates. In this theory, learners

are classified into four types according to their preferences of cognitive stages of learning: Accommodators, Divergers, Assimilators, and Convergers. Demirbas and Demirkan (2003) evaluated the effects of learning style preferences on the performance of design students using Kolb's Experiential Learning Theory and they found that there were significantly fewer students with the accommodating learning preference than other learning styles; in their sample, most students were assimilators and convergers. Their results indicated statistically significant differences between the performances of students with different learning styles in different stages of the design process.

The purpose of this study is to examine the effect of learning styles on the performance of selected students in design studio and also to increase the instructor's awareness of learning styles to lead flexibility in teaching and enhance the communication between instructor and design students. The identification of learning styles is based on Kolb's Experiential Learning Theory. The study then seeks to ascertain how awareness of this various learning styles can improve the communication between instructors and design students in design studio.

LITERATURE REVIEW

Architectural education began in Europe during the 17th century. Before that time architecture was taught as an apprenticeship. The Ecole des Beaux-Arts was established in 1795 in Paris. It had a great effect on the teaching of architecture in North America and Europe. The Bauhaus that followed the Ecole des Beaux-Arts was a school that relied on an educational foundation that included all the fields of architectural creativity with the idea of the basic unity in architectural education and began from zero under the supervision of a master (Salama & El- Attar, 2010). The foundation of the educational studios within the architectural discipline was laid with the educational program, the goal of which was to unite them. The programs were designed to introduce students to the basic principles of creativity and the various movements of the visual arts (Olotuah, 2001). One sees

that the teaching method gained importance through the Bauhaus student-teacher (master-apprentice) interaction. The model of architecture education has been widely referred to as the European and American model (Olotuah, 2006). Architectural education in Nigeria started with the establishment of the Nigeria College of Arts, Science and Technology Ibadan, Oyo state in 1952. It was relocated to Zaria in Northern Nigeria in 1955 and in 1962, the first Department of Architecture was established at the Ahmadu Bello University (ABU) Zaria (Arayela, 2001). This was then followed by the University of Nigeria, Nsukka and University of Lagos, Akoka. Presently, about 30 schools were accredited for undergraduate and 15 schools for post graduate architecture programmes.

According to Stotsky (2012), curriculum is a plan of action that is aimed at achieving desired goals and objectives. The curriculum of architecture in Nigerian schools of architecture is designed according to the British and American architectural education systems. 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 (Cross, 2011). In some way the studio experience for architecture students resembles an apprentice workshop: 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). This is the testing ground for the student to demonstrate control and command over his creative abilities. Beginning with a basic and elemental design project in the first year, the students will then progress into much more complex building projects.

Assessment is a process used to measure the academic progress of students on projects that portray real-world problems. It consists of

three core areas: knowledge, skills, and abilities, provides a context for the critical analysis of a studio project, and a broad learning opportunity for both students and staff (Webster, 2006; Alagbe et al., 2014). The key feature is that it requires the student to produce something, such as a report, experiment, or performance, which is then scored against a criterion. The architectural jury system is a widely used assessment tool for students in architecture schools globally where students present their works and get feedback/criticism. Student performance assessment serves two purposes: one is to guide, motivate, reinforce student learning and the other is to ensure academic standards.

According to researchers and educational philosophers, there are several ways of learning, that is to say that individuals differ in their preferred way of absorbing, collecting and retaining information. Many different dimensions of learning styles have been investigated and numerous theories and multiple models attempting to describe how people think and learn have been proposed; among them are the Dunn and Dunn Model, the VARK Model, Felder-Silverman Model and Kolb's Experiential Learning Theory. While there is ample evidence that individuals differ in how they prefer to take in, process, and acquire new information, the educational implications of such preferences have been a source of great controversy among researchers and educators over the years (Pashler et al., 2009).

Few studies have found validity in using learning styles in education, critics say there is no consistent evidence that identifying students individual learning style and teaching for specific learning styles produces better performance. Advocates of learning styles assessment in instruction believe that learning styles can be measured and used as a valuable teaching tool inside the classroom (Sims et al, 1986; Cornwell & Manfredo, 1994; Mainemelis et al., 2002; Rutz, 2003; Sternberg et al., 2008). According to these scholars, by diagnosing students' learning styles and matching them to teaching methods, learning can be greatly enhanced. Other scholars however have debunked the claim

that tailoring instruction to students' individual learning styles does not lead to better learning outcomes in instruction (Iliff, 1994; Kayes, 2002; Willingham, 2005).

Kolb 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. 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). Though five more categories have been added to the original four categories in order to make it nine categories. Various researchers however still incline to maintain the original four categories of learners for their study.

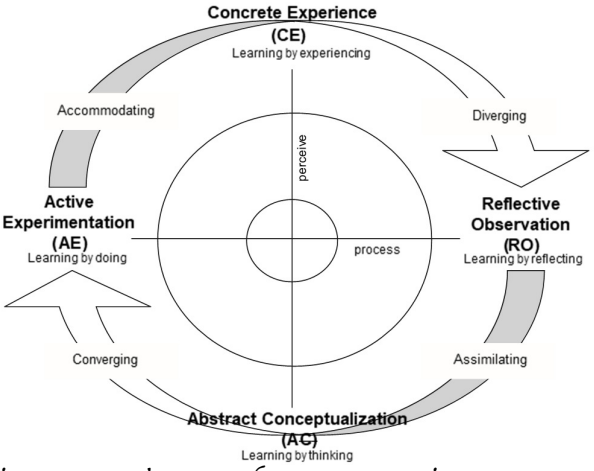

Figure 1: Four learning phases of Experiential Learning Theory
Source: Kolb, 1984

Accommodating learners perceive through Concrete Experience (CE) and process through Active Experimentation (AE). Accommodators learn primarily from "hands-on" experience. They prefer to take risks and they enjoy finding out new experiences. They solve problems using a trial-and-error method instead of their analytical abilities. Also, these learners rely on others for information and they prefer to work with others to do assignments, to set goals, to do field work and to test various approaches for design alternatives (Kolb & Kolb, 2005). Diverging learners perceive through Concrete Experience (CE) and process by Reflective Observation (RO). They are less concerned with theorems and generalisations. Their approach to problem solving is not systematic, but is more creative in comparison to the other learning styles. These learners when working in-groups listen to the suggestions of others and accept critiques from them.

Converging learners perceive through Active Conceptualisation (AC) and process by Active Experimentation (AE). Convergers are best at finding practical use to theories and ideas and are good at solving problems and making decisions. Kolb suggests they prefer dealing with technical tasks than with social and interpersonal issues. Assimilating learners perceive through Active Conceptualisation (AC) and process

by Reflective Observation (RO). They experience their world symbolically and transform information through thought (Demirbas & Demirkan, 2003). They are more concerned with abstract concepts rather than practical applications. These learners prefer readings, lectures and exploring analytical models (Kolb & Kolb, 2005).

In summary, Accommodators understand facts and evidence from concrete experience and process it from active experimentation. Divergers understand facts and evidence through concrete experience and convert it through reflective observation. Convergers understand facts through abstract conceptualisation and convert it through active experimentation Assimilators understand evidence from abstract conceptualisation and convert it through reflective observation. There have been some empirical studies which suggest that there are disciplinary differences in learning styles and that the dominant style in architects is the accommodator learning style (Kolb & Kolb, 2005). Demirbas and Demirkan (2003) evaluated the effects of learning style preferences on the performance of design students using Kolb's ELT; they found that the number of accommodating students was lower than that of other learning styles and most students were assimilators and convergers and that there were statistically significant differences between the performances of students with different learning styles in different stages of the design process. There are also a number of studies that have examined the relationship between learning style and academic performance in various disciplines, while some research indicates relationships between performance scores and the converging learning style, others argue that there is in fact no relationship between learning styles and students' performance.

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 successful in the architectural design studios than assimilators (Kvan & Jia, 2005). In another study, Demirbas and Demirkin (2007) focused on the learning styles and their relationships with gender and scores related to

four artistic, technical, basic and design courses and new student's total grade point average in three consecutive semesters. In this study, the student's convergent and assimilating learning styles were the students' preferences. No significant difference was found between gender and learning styles although male student's scores were higher in technical courses than the females. Significant difference was found in students' design scores with divergent and convergent learning styles while this difference was higher in design students, compared with convergent learning styles.

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 the design students' dominant styles during the first year were diverging (44%) and assimilating (32%) 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). This present study goes further to examine the learning styles of students in design studio modules.

METHODOLOGY

In this study, a quantitative research approach will be employed. This type of research places more emphasis on collecting data in the form of numbers (MacMillian & Schumacher, 2001). This actively demonstrates that statistics will have an important role as a tool to analyse the data collected. The design for this study is the descriptive method of research which is appropriate for describing the learning style of the study population and for exploring possible relationships between learning style and selected characteristics of the population (Durrheim, 2004; Ahuja, 2010). The sample for the study was selected

by purposive random sampling of second- and fourth-year students in the Department of Architecture, University of Jos. The reason for selecting these is based on the assumption on the longitudinal research of Kolb and Kolb (2005) that shows increasing movement in learning style from a reflective to an active orientation through higher education years. A 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.

Four learning styles, namely Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualisation (AC) and Active Experimentation (AE), will be obtained using a total of the students' responses ranked from 1 (least compatible) to 4 (most compatible) options for each question. The scores of Abstract Conceptualisation were deducted from Concrete Experience (AC-CE) while the scores of Active Experimentation were deducted from Reflective Observation (AE-RO). Then, the students will be classified into one of four learning styles namely divergent, accommodating, assimilating and convergent styles. The students' learning style is then analysed against graded design studio performance between A to F for a comprehensive discussion of the study aim. 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 Kolb's Learning Style Inventory test, one of the popular instruments for describing learning styles was used to determine which learning styles were predominant among architecture students. By carrying out this study on two different samples who are architecture students from two academic years, it was found out that there was a specific distribution of learning styles for architecture students. Table 1 gives a summary of the responses from the students in both programmes (second- and fourth-year) on the Kolb's Learning Style Inventory (LSI) test.

Table 1: Summary of responses to Kolb's Learning Style Inventory (LSI) test

No.	Question	Frequency	Percent (%)	Cumulative Percent
1.	**When tasked with a new design project…**			
	I like to try out new methods /approaches	5	12.2	12.2
	I like to watch and observe others work	16	39.0	51.2
	I like to spend time analysing the design problem	8	19.5	70.7
	I like to get practical with any design project	12	29.3	100.0
	Total	41	100.0	
2.	**I get my design inspiration from…**			
	My intuition/gut feeling	17	41.5	41.5
	Observing others work carefully	12	29.2	70.7
	Studying about a variety of building theories and ideologies	8	19.5	90.2
	Visiting building construction sites	4	9.8	100.0
	Total	41	100.0	
3.	**During design studio…**			
	I get involved in discussion	10	24.4	24.4
	I am quiet and reserved	17	41.6	66.0
	I tend to reason logically	4	9.6	75.6

	I imagine design problems in real life situations	10	24.4	100.0
	Total	41	100.0	
4.	**I design…**			
	Spontaneously	8	19.5	19.5
	From observations	10	24.4	43.9
	Rationally	13	31.7	75.6
	Practically	10	24.4	100.0
	Total	41	100.0	
5.	**I approach design with…**			
	An open mind	5	12.2	12.2
	Careful observations	14	34.1	46.3
	Logical thinking	7	17.1	63.4
	Practically	15	36.6	100.0
	Total	41	100.0	
6.	**When I am designing…**			
	I am an intuitive person	7	17.1	17.1
	I am careful and observant	10	24.4	41.5
	I am thinking reasonably, looking for arguments	16	39.0	80.5
	I am an experimental person	8	19.5	100.0
	Total	41	100.0	
7.	**I design based on…**			
	Personal experiences	2	4.9	4.9
	Observations	12	29.2	34.1
	Rational Theories	9	21.9	56.0
	Real-life scenarios	18	44.0	100.0
	Total	41	100.0	

Table 1 (cont.): Summary of responses to Kolb's Learning Style Inventory (LSI) test

No.	Question *(cont.)*	Frequency *(cont.)*	Percent (%) *(cont.)*	Cumulative Percent *(cont.)*
8.	**When I design…**			
	I feel personally involved in things	8	19.5	19.5
	I take my time before designing	20	48.8	68.3
	I like to work with ideas and theories	5	12.2	80.5

	I like to see results from my work	8	19.5	100.0
	Total	41	100.0	
9.	**I produce my best designs when…**			
	I can follow my intuition	9	21.9	21.9
	I take down criticisms from others work	11	26.9	48.8
	I analyse the design problem thoroughly	7	17.1	65.9
	I can carry out experiments	14	34.1	100.0
	Total	41	100.0	
10.	**For any new design project…**			
	I rely on my gut feeling	18	44.0	44.0
	I take my time before starting the design project	12	29.2	73.2
	I refer to existing theories and rationale	8	19.5	92.7
	I start working immediately	3	7.3	100.0
	Total	41	100.0	
11.	**When a design brief is given…**			
	I like to follow my intuition	12	29.2	29.2
	I like to observe others work first	17	41.5	70.7
	I like to evaluate the brief	8	19.5	90.2
	I like to start working on my design	4	9.8	100.0
	Total	41	100.0	
12.	**I produce my best designs when…**			
	I am working with others	3	7.3	7.3
	I take my time to think before designing	14	34.1	41.4
	I am working with reasonable theories	9	21.9	63.3
	I can try things out and practice	15	36.6	100.0
	Total	41	100.0	

As stated in the methodology, the computed deductions are derived from the weighted learning styles namely concrete experience (CE) – 1, reflective observation (RO) – 2, abstract conceptualisation (AC) – 3, and active experimentation (AE) – 4. 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 divergent, accommodating, assimilating and convergent styles given on Table 2.

Table 2: 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

The results showed that among the students that participated, the distribution tended to be greater in favour 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 analysis continued with a cross-reference of the student preferred learning style with their performance in design studio programmes of which records were 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 assesses the student concept formulation techniques, functional requirements, presentation techniques and oral presentation skills, the results of which are given on Table 3.

Table 3: 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

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

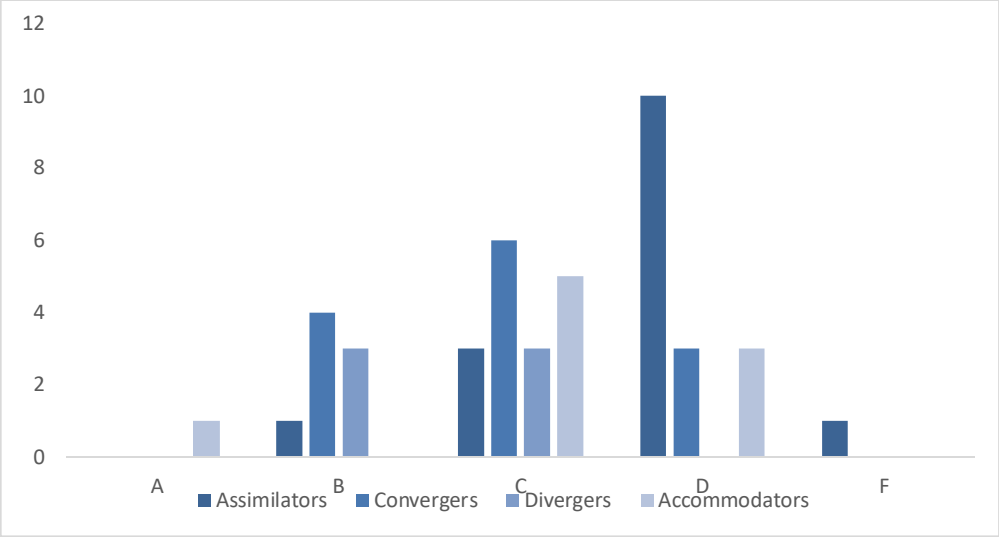

Figure 2: Grade distribution by learning style in second- and fourth-year students

As seen in Figure 2, the grades were not evenly distributed 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.

From Table 3 it is evident that there are significant differences in the performance of students in architectural design studio across learning styles. When cross-referenced against Figure 2 for further analysis, the study findings clearly indicate that learning styles are distributed across design studio performances. However, in the sample observed, more Assimilators are middle- to bottom performers and most top-performers are Accommodators. Divergers and Convergers are typically middle-performers in design studio. As this study is largely exploratory in its presentation, it leaves room for further discussions on other factors of design student behaviour and learning outcomes – such as personality type, intelligence level (learned or inherited), emotional intelligence and environmental influences – on architectural student overall performance.

CONCLUSION

The study sought out to explore the effect of learning styles on students' performance in design studio. By using Kolb's Experiential Learning Theory (ELT) using the Learning Style Inventory (LSI) on a sample of second year and fourth year architecture students in the University of Jos, Nigeria. The study findings reveal that a design studio learning can encompass a wide range of styles. This study underscored a link between learning styles of students and their performance in design studio. Furthermore, the findings indicate significant differences in the performance of students in architectural design studio across learning styles. The study showed that most students in the sample were Assimilators and Convergers, however, Accommodators were better performers in the design studio. The study findings strongly suggest that recognising the association between learning styles and performance in design studio will necessarily lead to both more perceptive teaching and also more

responsive learning. This, in turn will provide insight into how to address the diverse learning styles of architecture students, particularly those whose learning style is often at odds with traditional architectural design curriculum. Design studio programmes ought to give the opportunity to utilise different learning styles in design process by providing different learning experiences that employ different learning styles during design process.

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