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Evaluating Student Learning Outcomes Using Kolb Learning Style Inventory

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ABSTRACT

Student Learning Outcomes (SLOs) play a crucial role in contemporary educational curricula. While a considerable body of research has focused on the development and effectiveness of SLOs, there has been limited exploration of their use for examining other academic phenomena. A school's teaching philosophy is of critical importance, and course content needs to be designed in alignment with this philosophy. Hypothesizing that the SLOs serve as a concise representation of the course content and a reflection of the school's underlying philosophy, this study proposes a methodology for evaluating SLOs as part of a broader goal to assess course content, given that SLOs provide measurability. Kolb's Learning Style Inventory (KLSI) was used as a tool, as it has been cited by scholars for its potential to provide insights into the perspectives of different types of learners. This includes students in various disciplines including architecture, the chosen discipline of this research. A questionnaire, designed by integrating KLSI and SLOs was administered in a case study of architectural design studios. Key findings suggest that the method demonstrates its potential to assess SLOs from the perspective of various types of learners. This includes, but is not limited to, determining whether the SLOs address diverse learner types across various academic levels, whether they prioritize specific learner types at different levels, and whether they maintain a consistent focus on particular learner types throughout all academic years. Additionally, a supporting finding suggests that this approach may provide rational justifications for the SLOs within architectural design studios, highlighting challenges in fully adhering to certain established standards. In this way, this paper introduces a novel application of SLOs in academic contexts and aims to contribute to the alignment of course content with the school's teaching philosophies, while potentially influencing student intake policies within the field of architecture.

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1. Introduction

Formal higher education has moved from a teaching-oriented to a learning-oriented curriculum (Weimer, 2013, McLean et. al. 2019). Student learning outcomes (SLO) were introduced in order to measure student learning. Specifically, it has focused more on outcomes than the learning process (CLO 2024). More concerns and efforts are now put into how much the students have learned in a course rather than how much has been taught, and a list of outcomes is set as a target the students must

produce at the end of the course to prove they have learned those. The teachers must find methods to successfully measure or assess what the students have learned at the end of the course and match it with the initial goal. Student Learning Outcomes (SLO) are those measurable sets of goals (Schuh & Upcraft, 2012. Similar to other disciplines, the field of architecture—the chosen discipline for this study—has also adopted Student Learning Outcomes (SLOs) on a global scale.

The SLOs serve as a concise representation of the course content, and as such, they have the potential to also reflect the teaching philosophies of the school (Wiggins & McTighe, 2005). In this way, SLOs can be explored as a tool for assessing broader academic phenomena. This concept initiated the research inquiry of this study. However, it is important to first gain a brief understanding of SLOs and their effectiveness in disciplines such as architecture.

2. Literature Review

2.1 Student Learning Outcomes (SLO)

2.1.1 Definition and Significance

The concept of SLO is not new. SLOs have a long history in education, influenced by pioneers such as BF Skinner, JB Watson, and Ivan Pavlov in the 19th and 20th centuries (Adam, 2004). SLOs, which originated in the behavioral school of psychology, emphasize precisely identifying and measuring learning outcomes. Education professionals worldwide improved the 'learning outcomes approach' due to this focus on observable and quantifiable results, trying to bring consistency to different disciplines in the broader fields of Science, Arts, Commerce, Social Science, and others.

The important part is that they have been standardized over time. SLOs outline the information, skills, abilities, attitudes, and understanding that students should possess and be able to demonstrate at the end of a learning period. They provide a methodological framework for articulating learning objectives and guarantee that they align with academic aims in all disciplines (Adam, 2006). Here are some examples of SLOs.

Examples in Physical Science:

- Students will be able to **demonstrate** an understanding of core knowledge in biochemistry and molecular biology.
- Students will be able to **apply** critical thinking and analytical skills to solve scientific data sets.
- Students will be able to **apply** the scientific method to solve problems.

Example in Social Science:

- Students will be able to **demonstrate** fluency with formal vocabulary, artistic techniques and procedures of two-dimensional and three-dimensional art practice.
- Students will **demonstrate** in-depth knowledge of artistic periods used to interpret works of art, including the historical, social, and philosophical contexts. (CLO, 2024)

The SLOs target to make the students 'be able to' 'do' 'something.' This 'something' is described through several Power Verbs, as shown in bold in the example above. The set of these Power Verbs has also been standardized over time. 'Learning' in education belongs to the 'cognitive' domain, one of the three domains mentioned in Bloom's definition of domains, and it deals with intellectual abilities (CLO, 2024). Then, the different learning steps are categorized into six levels, from simpler to gradually more complex. Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating (CSA 2024). The SLOs representing these six levels can best be articulated using certain Power Verbs. Around 20 such Power Verbs have been suggested to be included under each of these six levels, from which the academicians can pick. The student's academic levels are synchronized with these levels, which means that in the lower academic levels, students are more likely to remember or understand, while the higher-level students are more likely to evaluate or create (Bloom, 1956; Ruhl, 2024). It is more elaborated in the following sub-section.

2.1.2 Use of Power Verbs to construct SLOs

As mentioned, Bloom's Taxonomy is a well-known framework for classifying learning objectives into categories typically used to generate SLOs. Cognitive (intellect-based), affective (emotion-based), and psychomotor (skills) are the three major domains in learning, and the levels of taxonomy are assigned to the cognitive domain when it comes to classroom learning. For instance, understanding-based outcomes use Power Verbs like 'define', 'list', and 'recognize', whereas critical analyzing-based outcomes use Power Verbs like 'analyze' and 'compare' (Mahajan & Singh, 2017). Regardless of the domain and taxonomy levels, SLOs should always contain a Power Verb (UNO, 2024).

Irrespective of any discipline, certain Power Verbs can be used depending on the academic level. For example, in the introductory levels like freshmen, Power Verbs can relate to Bloom's taxonomy levels of 'remembering' and 'understanding'. In the capstone level, such as seniors, Power Verbs can relate to Bloom's taxonomy levels of 'evaluating' and 'creating'. Therefore, whether it is Science, arts, social science, or applied science, a certain attempt is made to achieve measurability and inter-disciplinary comparability in their learning outcomes. (UNO, 2024).

From the discussion above, the following figure shows a conceptual relationship between Bloom's Domains, Taxonomy Levels, and academic levels.

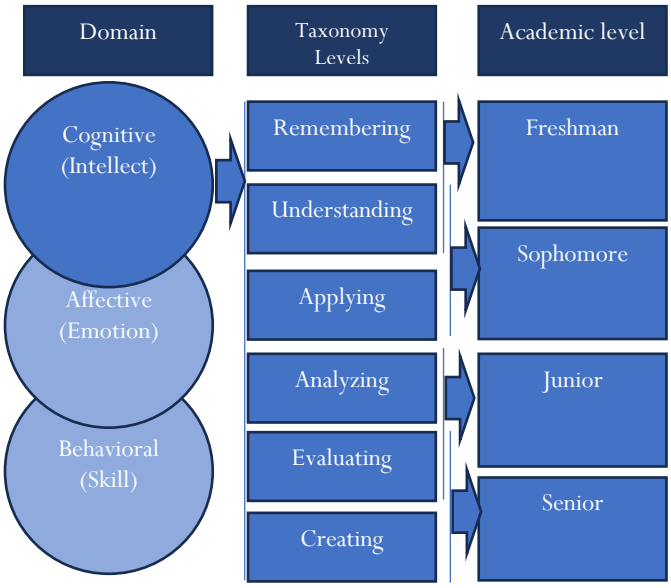

Figure 1 Interrelationship between the different components of Formal Learning (Source: Authors)

2.1.3 Other Implicit Characteristics of SLOs

Apart from the linguistic formats, there are some other physical traits the SLOs have adopted over time. These are discussed below.

a. Complex Sentences Should Be Discouraged

It is essential that readers are able to comprehend the specifics of the Student Learning Outcomes (SLOs). The use of complex sentence structures can hinder this understanding, as they require more time to process and may discourage careful reading. Therefore, SLOs should be articulated as clear, concise explanatory statements (Larsen, 2011).

b. Difficult Terminologies Should Be Avoided as They Make Things Difficult to Understand

While the use of discipline-specific terminology is crucial for ensuring the precise articulation of Student Learning Outcomes (SLOs), an overreliance on complex terminology may disengage students, particularly in a diverse learning environment. Employing a single, clear power verb in each SLO provides the most effective means of conveying expectations to learners, promoting clarity and accessibility (UA, 2021).

c. Choosing the Right Power Verbs Is the Most Crucial Part Of Writing Efficient SLOs

Over time, a curated list of Power Verbs has been established, designed to be easily comprehended by students across varying levels of proficiency. When developing Student Learning Outcomes (SLOs), it is crucial to align the chosen verb with the skill level that the instructor expects learners to attain. For students enrolled in higher education programs, expectations typically entail a high level of performance. The list of Power Verbs continues to evolve, and selecting the most appropriate verb remains a key responsibility of the instructor. This decision reflects the instructor's ability to articulate the desired outcomes at specific levels of mastery within the discipline (Larsen 2011).

d. Identical SLOs Should Be Avoided

This is self-explanatory, as the underlying intent of the Student Learning Outcome (SLO) remains unchanged regardless of the specific wording. While variations in phrasing may alter the emphasis or tone, they do not fundamentally alter the core expectations or the skill level being assessed. The critical factor in defining an SLO is the clarity and precision with which it communicates the desired learning outcome, rather than the specific choice of language used.

e. The Number Of Slos For A Particular Studio Should Be Limited

Another important consideration is that a reduced number of Student Learning Outcomes (SLOs) enhances readers' ability to maintain focus and engagement. While no exact number can be universally prescribed, research suggests that an increase in the number of SLOs may lead to greater difficulty in sustaining concentration. It is generally recommended that the number of SLOs be limited to between 5 and 10 per course or studio, with an emphasis on the most essential and relevant outcomes. This approach ensures that the SLOs remain focused, clear, and manageable for both instructors and students (Boye, 2024).

f. Shorter Sentences Are Easier To Understand

Considering the diverse backgrounds and varying levels of academic preparation among students, it follows that shorter sentences enhance readability and comprehension. Concise language minimizes potential confusion, allowing students to more easily grasp key concepts. Moreover, shorter sentences promote clarity and reduce the cognitive load required to process complex information, particularly for those who may be

less familiar with the subject matter or having less linguistic proficiency (CLO, 2024).

2.2 Difficulties in Constructing A Reliable Set of Slos In Architecture

The selection of Power Verbs is constrained, as is the overall structure of Student Learning Outcomes (SLOs), which adhere to certain standardized characteristics. These constraints combine to create a formulaic approach that is applicable across disciplines (Geddes, 2023). However, there is ongoing debate regarding the appropriateness of applying a uniform SLO structure across all fields of study. Critics, particularly within creative disciplines, argue that such formulaic approaches may undermine originality and creativity by shifting the focus from process-oriented learning to outcome-based objectives (Northwood, 2013). This raises important questions about the flexibility of SLO frameworks in disciplines where innovation and creative expression are central.

A process is considered reliable if it consistently produces the same results when the same methods are applied within the same context (Cohen et al., 2017). SLOs are designed to enhance the reliability of teaching and the measurability of learning, with the expectation that a uniform set of SLOs will yield comparable outcomes among students at the same academic level (Powell & Saint-Germain, 2016). This framework is often more effective in fields such as science and applied sciences, where course objectives and goals are more readily quantified and assessed (Entwistle, 2005). However, the same cannot always be said for disciplines in the humanities, commerce, social sciences, or creative fields (Northwood, 2013). While established theories in the humanities, commerce, or social sciences may allow for measurable and quantifiable outcomes when curricula are developed in alignment with these theories, creative disciplines—such as architecture—present greater challenges. In these fields, the foundational concepts that inform design practice are not universally standardized, making it more difficult to apply a consistent, measurable framework like the SLOs.

The discipline of Architecture is particularly complex, as it straddles both creative and social science domains. Architecture intersects with social science in its focus on human interactions within the built environment. While social science addresses societal issues and human behavior, architecture concerns itself with the design of buildings and environments. However, the ultimate success of a design is measured by its impact on its users. For instance, an architect must understand how individuals behave within the spaces they design. The users are 'people,' which refers to society (Wood, 2017). In this regard, it is essential that the SLOs in architecture are also aligned with the theoretical frameworks of social science to adequately address the human dimension of design.

However, as mentioned, the creative part of Architecture makes it challenging to generalize the construction of the SLOs. The technique of delivering and receiving knowledge in a design studio differs from a conventional lecture. The Design Studios are interactive, where two-way communication is the more effective way in the classroom (Wong, 2023). A studio is a place where students practice a certain set of abilities, either alone or with the guidance of an instructor. The instructor works with the students during the scheduled class period, and after that, the students finish their work alone (Lueth, 2008). Therefore, the SLOs might need to be formulated uniquely, as the role of the instructor and the role of the classroom environment might also impact creativity significantly. Whatever their role is to affect the student's learning, the SLOs do not necessarily care about it, as SLOs are more interested in measuring the outcomes rather than the 'process.' Therefore, these qualitative influences were kept beyond the scope of this study.

Ultimately, standardized SLOs can be useful, but they should not be so rigid that they inhibit the creative freedom needed for artistic disciplines to flourish. Ideally, they should provide a foundation while allowing space for individual growth and experimentation. This leads to the conclusion that even in creative disciplines as in Architecture, SLOs are an integral part of any educational program (Lattuca & Stark, 2009; Long et. al., 2022). One important field of inquiry would be whether the SLOs in the current schools of architecture follow common physical traits. This inquiry has been formulated as the first research question addressed in this paper.

2.3 The content of the SLOs and its significance in professional disciplines such as architecture

The content of Student Learning Outcomes (SLOs) reflects the syllabus. A pertinent question may arise regarding whether the course content or the syllabus is regularly updated to align with the demands of the job market, especially if it is a professional discipline such as Architecture. A curriculum's syllabus should ideally align with the needs of the job market to ensure graduates are equipped with relevant, employable skills. Proponents of this view argue that by tailoring the syllabus to industry demands, students gain practical knowledge that directly applies to their future careers, enhancing employability and ensuring they are ready to contribute effectively in their professional fields (Knight & Yorke, 2004). This alignment also helps bridge the gap between academic theory and real-world application, making education more valuable and responsive to societal needs. However, critics argue that an overly job-market-driven curriculum may limit students' intellectual freedom and creativity, particularly in fields like architecture or the arts, where innovation and critical thinking are just as important as practical skills. A purely market-oriented approach might restrict exploration, and the development of a broader, more adaptable skill set that can thrive in dynamic work environments (Guri-Rosenblit, 2009). Therefore, while aligning a curriculum with the job market can improve graduates' readiness, it is essential to strike a balance with broader educational goals that encourage creativity, critical thinking, and life-long learning. While the relationship between course content and the job market is a significant area of inquiry, it falls outside the scope of this study.

A school's teaching philosophy is of critical importance, and course content needs to be designed in alignment with this philosophy. This research primarily focuses on identifying a methodology to assess whether a school's philosophy—whether

oriented toward the job market or intellectual creativity—can be effectively measured. SLOs serve as a concise representation of the course content and can reflect the school's underlying philosophy. Additionally, they possess measurability (Such and Upcraft, 2012). Consequently, SLOs were the focal point of this investigation.

2.4 Investigating the Types of Learners as A Logical Approach to Evaluate SLOs

While SLOs are driving education toward a more learner-centered approach, it would be beneficial at this juncture to understand the various types of learners, particularly within the field of architecture.

Learners can be categorized in various ways, with numerous terms used to describe these classifications. When it comes to architectural learners, however, more scholarly research has demonstrated that they can be broadly grouped into visual and verbal categories, which correspond to the active and reflective types, respectively. Kolb's framework, however, offers a more systematic and measurable approach to categorizing learning styles. His model identifies four distinct learning types: Divergers, Assimilators, Convergers, and Accommodators. This framework is not only well-defined but also relatively easy to understand and can be effectively utilized as a research instrument (Kolb 1984).

Kolb's typology of learners provides a more straightforward framework for examining the diversity of learner types. Therefore, connecting the SLOs of architecture with Kolb's four learning styles became the central method in this study, which aimed to determine whether the design pedagogy in the studio addresses all learner types. Since SLOs are designed to make education more learning-oriented, using learner types and choosing a simpler one such as Kolb's Learning Style Inventory (KLSI) to evaluate a course presents itself as a logical approach.

2.5 The Different Types Of Learners

Since SLOs tend to focus more on the 'learning' outcomes rather than the 'process' itself, students' learning styles represent a critical factor to consider in their development.
According to Kolb, each of these four distinct types of learners corresponds to a progressive stage of development. Moreover, an individual's position within these stages is not fixed; rather, they may transition between stages throughout different phases of their life (Kolb & Kolb, 2009). This dynamic nature of learning stages is further elaborated in the following sub-section.

2.5.1 The Four Stages of Learning in a Cycle

KLSI is widely recognized as a valuable tool for assessing students' learning preferences. According to KLSI, the learning cycle unfolds in four stages: 'feeling,' progressing to 'watching,' then 'thinking,' and culminating in 'doing' (Kolb 1984). These stages are delineated as Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE) (Figure 2a).

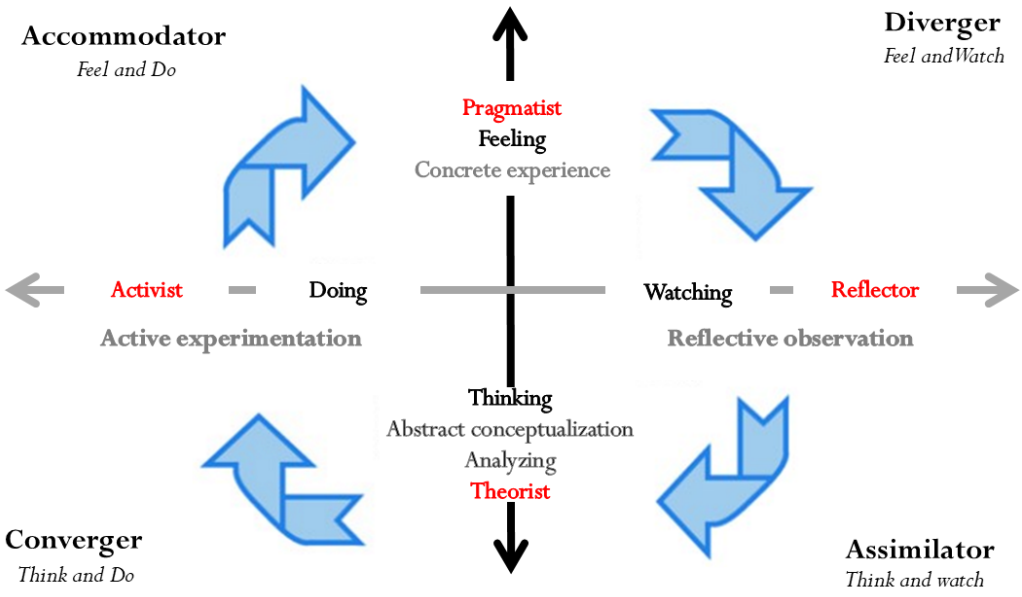

Figure 2 The four stages of Learning Cycle, and the four categories (Kurt 2020, Robinson 2002)

2.5.2 The Four Groups Of Learners: Diverger, Assimilator, Converger, And Accommodator

However, subsequent concept development suggested that one's learning style is likely a blend of two consecutive stages (Kolb & Kolb 2009). Consequently, four distinct groups of learners emerged: Divergers (feel and watch), Assimilators (watch and think), Convergers (think and do), and Accommodators (do and feel) (Kolb 1984). It is also suggested that individuals possess all four stages. Yet, the values of AC – CE and AE – RO serve as clear indicators of the quadrant they inhabit, as AC and CE and the other two stages exhibit a linear relationship. Thus, the values of (AC – CE) and (AE – RO) are the primary determinants of one's learning style (Joy & Kolb 2009).

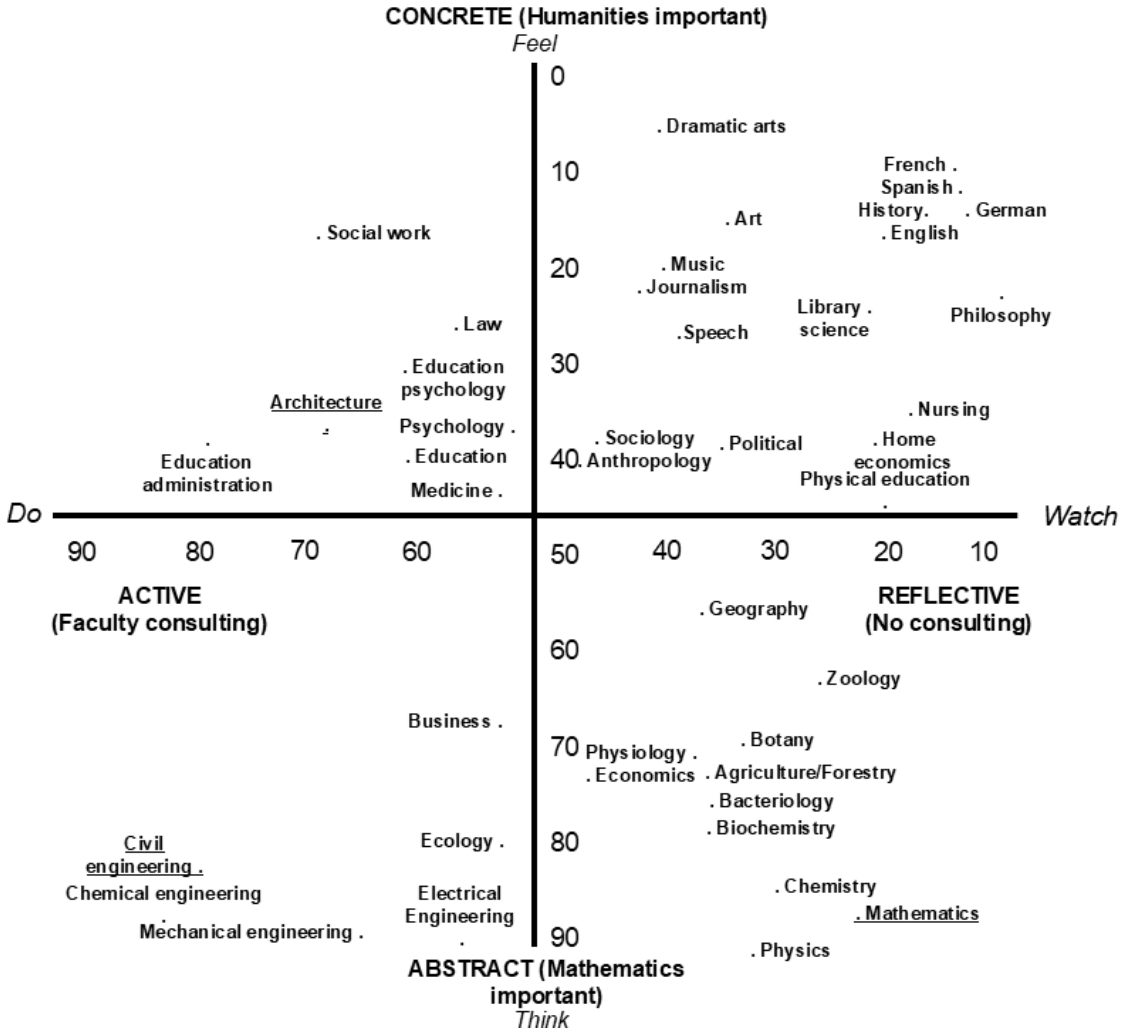

Figure 3 The four personalities and the location of Architects in the category of Accommodators (Joy & Kolb 2009, Kolb 1984)

2.5.3 Alignment with Professions and Its Support and Critics

Following an extensive investigation, various professionals have been categorized within specific quadrants (Joy & Kolb, 2009). For instance, architects are placed in the Accommodators' quadrant, a group characterized by sociability and a preference for both 'doing' and 'feeling,' with a slight emphasis on the 'doing' aspect (Figure 3).

Kolb's theory has both proponents and critics. Nevertheless, over the years, it has consistently served as a foundational framework for research on learning styles. Ongoing studies continue to explore the extent to which variables such as culture, gender, age, education level, and experience significantly influence learning styles (Khan et al., 2012).

2.5.4 Learning Styles of Architects and the conflict

Following extensive research, Kolb posited that architects predominantly align with the 'accommodator' category. However, contemporary studies suggest that architecture students may exhibit a range of learning styles, not limited to this classification (Demirbas & Demirkan, 2003). A critical question arises regarding whether the learning styles of students diverge from those of practicing architects as conceptualized by Kolb. Empirical evidence from various studies indicates that architecture students can belong to multiple categories of learning styles, with such patterns potentially varying across cultural contexts (Khan, 2023).

As architecture increasingly embraces interdisciplinary approaches and the traditional notion of pure creativity is no longer the sole determinant of success, it is not uncommon to find a variety of learner types in the classroom. This raises the intriguing question of whether the Student Learning Outcomes (SLOs) are aligned with any specific learner type, as might be expected in an ideal scenario. Another compelling area for exploration is whether the SLOs address the needs of different learner types across various academic levels—an aspect that has received limited attention in previous studies. This could present an intriguing opportunity to assess whether the evaluation of SLOs could lead to modifications in the syllabus or intake policy. This insight from the literature review prompted the formulation of the second research question, which examines how SLOs within the architecture discipline accommodate the four distinct types of learners.

2.6 The four Action Verbs and Their Relationship with the Architectural Pedagogy and SLOs

The immediate concern lies in the potential for the terms used by Kolb to be linked to architectural pedagogy. The four Action Verbs— 'feel,' 'watch,' and 'think', and 'do,' —can indeed be used in architectural pedagogy or any other educational context to evaluate or understand learner types. These verbs align with Kolb's experiential learning theory, which categorizes learning styles into four types based on how individuals process and perceive information:

- Feel (Accommodators and Divergers): These learners tend to learn by doing and feeling, reflecting the hands-on, action-oriented aspect of design education in fields like architecture.
- Watch (Divergers, Assimilators): Learners who prefer to observe and reflect, making them more attuned to visual learning, conceptual thinking, and reflective observation.
- Think (Assimilators, Convergers): Learners who prefer conceptualizing and thinking critically, engaging in deeper analysis, and structuring information, which can be valuable in architectural theory and problem-solving.
- Do (Accommodators, Convergers): These learners focus on active experimentation and applying practical solutions, fitting well within architectural design processes.

From another perspective, the four learner types can also be used in architectural pedagogy. For example:

- Accommodators (who prefer 'doing' and 'feeling') may thrive in hands-on studio environments where they can engage in physical creation and iterative processes.
- Divergers (who prefer 'watching' and 'feeling') may benefit from observational learning, case studies, or discussions.
- Assimilators (who prefer 'thinking' and 'watching') might excel in theoretical modules, research, or critical analysis of existing architectural works.
- Convergers (who prefer 'doing' and 'thinking') would likely excel in solving complex architectural problems, integrating practical skills with conceptual frameworks (Felder & Silverman, 1988)

Using these Action verbs or the learner types as a framework has the potential to allow educators to tailor their teaching strategies in architecture or any other field. SLOs are concise representations of the course content and the teaching philosophies. So, the Action Verbs or the Learner types can also be helpful in structuring the SLOs in order to align the course content or the teaching strategies (Gardner, 1993; Schon 1983). For this study, the four Action Verbs were used as a microtool instead of the four learner types due to their ease of understanding by any layperson. However, the four learner types were also used at a later stage.

Studies in pedagogical theory support this approach, acknowledging the value of aligning teaching methods with diverse learning styles to improve educational experiences. This framework helps to ensure that no particular learning style is left under-addressed, providing a more inclusive and effective pedagogical approach (Kolb, 1984, Felder and Silverman, 1988).

2.7 The Context Of The Study

The School of Architecture at a public University in the US was chosen as the case study for this research. A brief overview of the architectural education system in the US will be helpful at this point. The architecture schools in the US have varying programs and approaches, which can be categorized under three key points: duration, intake policies, and teaching philosophies (Dovey 2010, Kumar & Maiti 2016). Here's a brief overview of each.

The architecture schools in the US have varying programs in terms of duration. The first one is the 4-Year Undergraduate + 2-Year Master's Program (6 years total). They usually offer a 4-year Bachelor's in Science or Arts in Architecture, followed by a 2-year Master of Architecture (M.Arch). This structure is common in schools that offer a more general or liberal arts-focused undergraduate education. There is a 4-Year Undergraduate + 1-Year Master's Program (5 years total) as well. This structure allows students to earn both degrees in 5 years, with the 1-year M.Arch focused on professional licensing. It is a more streamlined professional path with the Bachelor's degree already a professional degree in architecture. It tends to prioritize core competencies and concepts, while leaving the more advanced, specialized, and professional preparation to the Master's year. Some schools offer a direct 5-year B.Arch program, combining both undergraduate education and professional preparation. There is also a 3-Year Undergraduate + 2-Year Master's Program (5 years total), which some schools offer. It is typically for students with a non-architecture undergraduate background (Biggs, 2003).

Intake policies and admission requirements vary significantly depending on the school. There are schools with tougher admission policies. These schools typically require high GPAs, competitive portfolios, and strong SAT/ACT scores. There are schools with more lenient admission criteria. They accept applicants with lower GPAs if they have a strong portfolio or relevant experience. Many architecture schools require a

portfolio, though some focus more on academic performance and may not ask for one (Chism, 2007).

In terms of philosophy, the approach to teaching varies. Some schools are more focused on art and creative design. Some others rely more on engineering and technology. Some others focus heavily on construction and practical aspects of building. In this way, these schools provide diverse paths depending on the student's interests and career goals (ibid).

The chosen case study has the (4+1) system, with comparatively lenient admission criteria and a focus on construction and practical aspects of building. The reason for using only one case study is that the aim of the research is to develop a methodology. This can serve as an initial version that may be refined over time. However, to introduce the concept of the method, a large amount of data is not necessary at this stage.

The study was conducted with five cohorts at five levels in a single academic year, four at the undergraduate level, and one at the graduate level. The decision to focus on only one academic year was made to avoid potential double-counting, as freshmen in a given year would progress to become sophomores, juniors, or seniors in subsequent years. While increasing the number of cohorts could also enhance the generalizability of the results, the primary objective was to develop a methodology that can be applied to any sample, regardless of size.

Addressing the use of Student Learning Outcomes (SLOs) in other schools of architecture would indeed be necessary if the objective of the study was to compare the significance of the Power Verbs used in these SLOs or evaluate which Power Verbs are more effective. Similarly, if the goal was to compare the philosophy across different schools, examining SLOs from various institutions would be important. However, this study is not focused on comparing the content of SLOs or determining which power verbs are most suitable for architecture programs. Instead, the objective is to assess whether the current SLOs adequately address the needs of all types of learners. It does not even try to measure the quality or the content of the SLOs of the case study. Rather, the aim of the study was to develop a method to analyze any given set of SLOs, explained through learning styles, that might provide insight into how the course content is aligned with the school's teaching philosophy.

3. Methodology

Connecting the SLOs of architecture studios with Kolb's four Action Verbs became the central method in this study, which aimed to determine whether the design pedagogy in the studio addresses all learner types.

The research used qualitative and quantitative approaches to answer the two research questions. A peer review was conducted to address the first research question. The studio instructors were involved in an intensive review session to give insights into the structure and content of the SLOs and whether they meet the common physical traits referred to in the literature review for being efficient SLOs.

To address the second research question, a questionnaire was administered to examine the relationship between the Student Learning Outcomes (SLOs) from each of the ten Design Studios and the four Action Verbs (Feel, Watch, Think, and Do). These four Action Verbs operationally represent the four types of learners in this study. The validity of the results was established through triangulation, comparing the responses of a randomly selected sample group with those of the respective studio instructors. The first group was a random sample chosen through convenience sampling. The validation process was necessary to establish a more reliable connection between the SLOs and the diverse learning styles of students. This process involved simplifying the SLOs into more straightforward statements and asking respondents to associate each SLO with the four Action Verbs, permitting multiple Action Verbs for a single SLO. These four Action Verbs served as a simplified representation of the four distinct learner types. Both the sample respondents and the peer group of the instructors received the same questionnaire, enabling the correlation of responses to verify the relationship between the SLOs and the identified learner types. After validation, the results were analyzed to identify patterns in the SLOs and assess their alignment with the four types of learners, both at individual academic levels and across all levels. Following this analysis, the results were utilized to derive the study's findings.

4. Results

The results from the validation stage are as follows. Each SLO from all the design studios was broken down into simple sentences to contain only one Power Verb. An example is shown below (Table 1). Then, these simplified SLOs were drawn against four Action Verbs so the respondents could relate them. Multiple Action Verbs could be chosen for one simplified SLO (Table 2). After calculating the responses, a sample t-test was used to validate the results statistically. Then, the responses from the survey participants and the peer reviewers were compared (Table 3). It is important to note that the connection between the Power Verbs and the Action Verbs may not be generalized to all disciplines, as the SLOs specifically pertain to Design Studios. Furthermore, the intent is not to generalize this relationship.

Table 1 Example of SLOs broken down for each sentence having only one 'Power Verb'

Be able to identify, describe, and apply Primary elements and principles of architectural design.	Be able to identify Primary elements and principles of architectural design.
	Be able to describe Primary elements and principles of architectural design.
	Be able apply Primary elements and principles of architectural design.

Table 2 Example showing one SLO having the option to be linked with one or more 'Action Verbs'

SLO: 1A	Action verbs
Be able to identify Primary elements and principles of architectural design.	Feel
	Watch
	Think
	Do

Table 3 Full list showing the relationship between the Power Verbs and the Action Verbs comparing the two groups of respondents.
(Note: The bold ones show matching between the two groups)

Power Verbs	Survey Responses				Responses from the Peer group			
Identify		Watch	**Think**				**Think**	
Describe			**Think**				**Think**	Do
Apply				**Do**				**Do**
Understand			**Think**		Feel		**Think**	
Communicate	Feel		**Think**	**Do**			**Think**	**Do**
Produce				**Do**				**Do**
Analyze			**Think**			Watch	**Think**	
Synthesize		Watch	Think	**Do**				**Do**
Develop			Think					Do
Demonstrate				**Do**				**Do**
Employ				**Do**				**Do**
Convey				**Do**				**Do**
Use				**Do**				**Do**
Evaluate			**Think**				**Think**	
Test				**Do**			Think	**Do**
Execute				**Do**				**Do**
Comprehend			**Think**		Feel		**Think**	
Establish			**Think**				**Think**	Do
Present				**Do**				**Do**
Utilize				**Do**				**Do**
Construct				**Do**			Think	**Do**
Prepare				**Do**				**Do**
Measure			**Think**			Watch	**Think**	
Make			Think	**Do**				**Do**
Design			Think	**Do**			Think	**Do**
Conceptualize			**Think**	Do			**Think**	
Integrate				**Do**			Think	**Do**
Practice				**Do**				**Do**

A correlation analysis was done using the results from the Peer reviewers and the survey respondents. The R-value showed a strong correlation between the responses of the survey participants and the peer reviewers ($R = 0.849$, $\sigma = 0.00$).

After the validation, the next step was to record the distribution of the four Action Verbs at different academic levels (Table 4 and Chart 1).

Table 4 Distribution of the Action Verbs in SLOs at different academic levels

Academic Level	F	W	T	D
Freshman	8%	13%	33%	46%
Sophomore	10%	8%	48%	35%
Junior	4%	19%	27%	50%
Senior	5%	5%	32%	59%
Grad	0%	8%	28%	64%
Total	**6%**	**11%**	**33%**	**50%**

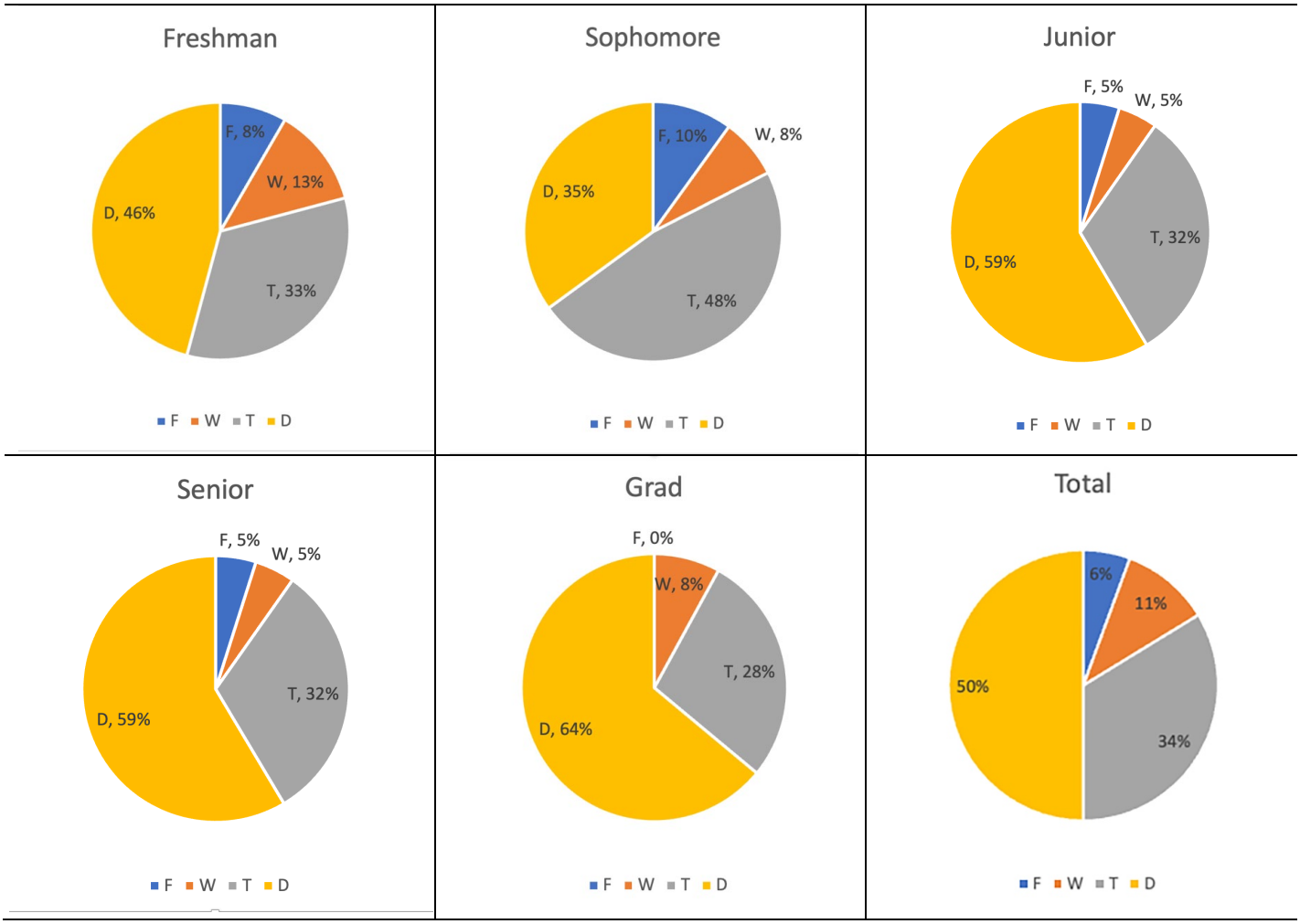

Figure 4 Distribution of the Action Verbs in SLOs at different academic levels in architectural design studios. (F: Feel, W: Watch, T: Think, D: Do)

5. Findings and Discussion

Responding to the first research question, several interesting findings were extracted.

The literature review emphasized the importance of structuring the SLOs in a way that enhances their comprehensibility for readers. Key strategies for achieving this include using simpler terminology, avoiding complex or compound sentence structures, favoring concise and straightforward sentences, minimizing repetition, and limiting the number of SLOs to a manageable amount. Power Verbs are also critical in ensuring that the essence of the SLO is clear and easily grasped. However, discussions during the peer review process revealed that the studio instructors in this study faced challenges in balancing these constraints. For example, limiting the number of SLOs often results in the inclusion of complex or compound sentences, while simplifying sentence structure tends to increase the overall number of SLOs. The responses included, creative disciplines, in particular, may struggle with this issue, as they frequently address qualitative aspects that are difficult to encapsulate within a small number of SLOs. Creativity involves not only generating innovative ideas but also addressing the constraints within each design studio. As such, it is challenging to represent these multifaceted considerations in a limited number of SLOs. This tension typically results in either a large number of simple SLOs or a smaller set of more complex or compound statements.

Recent research has explored methods for organizing SLOs into a generalized structure that can accommodate multiple elements while remaining comprehensible. Geddes (2023) suggests that an effective SLO should include three precise components: content, cognition, and conception. This approach allows for the grouping of related factors under a single content category, provided the cognitive aspect remains consistent. This could make even compound or complex sentences easier to understand. However, further research is necessary to develop a standardized and widely accepted framework for constructing SLOs that can balance complexity and clarity.

In response to the second research question, several noteworthy findings emerged. The 'Feel' component was consistently underrepresented across all levels, with its presence diminishing

at higher academic levels. According to Kolb's model, the 'Feel' component plays a pivotal role in fostering creativity, particularly among 'Divergers,' who are often associated with disciplines within the creative industries. Architecture, as a field traditionally aligned with the creative sector, has long been recognized for its emphasis on creativity. Therefore, the decline in the 'Feel' component in SLOs may suggest a shift away from creativity within the discipline. Furthermore, the progressive reduction of the 'Feel' component at higher academic levels may indicate that creativity is being given less prominence as students advance. It is possible that school's philosophical approach plays a role here, which was beyond the scope of the study.

The 'Do' component emerged as a central element across all academic levels, with its prominence increasing progressively at higher levels. According to Kolb's learning theory, architects are classified as 'Accommodators,' a category that incorporates both the 'Feel' and 'Do' components. The position of the architecture discipline within Kolb's learning grid (Fig. 3b) further suggests that the 'Do' component may outweigh the 'Feel' component, as it is situated closer to the horizontal axis than the vertical axis. This suggests that while the 'Feel' component is essential for fostering creativity, architects also require a substantial emphasis on the 'Do' component to translate that creativity into practical application. The predominant presence of the 'Do' component in the SLOs across all academic levels, along with its continuous increase at higher levels, aligns with the logical expectation that applying knowledge to real-world contexts is of paramount importance. This pattern also aligns with the higher levels of Bloom's Taxonomy (Figure 1), which emphasizes 'creating' at the Junior and Senior levels, mirroring the focus on the 'Do' component in Kolb's model.

An examination of the pie charts (Figure 4) reveals that, aside from the gradual decline of the 'Feel' component, the distribution of the 'Watch,' 'Think,' and 'Do' components in the SLOs remains relatively consistent across all academic levels. Each component shows a progressive increase over the preceding level, with the exception of sophomores, where the 'Think' component is dominant. This stable distribution suggests a balanced representation of the four components throughout the academic levels, with the concentration of the 'Think' component at lower levels serving a useful purpose. According to Bloom's Taxonomy (Fig. 1), the 'Understanding' component is particularly relevant at the Freshman and Sophomore levels, which is relevant to 'Think' in terms of Kolb's definition (Felder & Silverman, 1988). A possible suggestion can be drawn here that it might probably be more effective if the concentration of the 'Think' component is increased in both the Freshman and Sophomore levels. However, this suggestion is not intended to critique the current SLOs of the school, as they are regularly subject to change and improvement. Rather, it emphasizes that the findings provide an opportunity to reflect on the course content and teaching philosophies.

Another key finding was that the four components were not equally distributed across the academic years. Kolb's theory conceptualizes these components as progressive stages, which implies that the 'Feel' component should gradually diminish while the 'Do' component increases over time. However, few studies have examined the specific time intervals or life stages that might drive these shifts. Thus, it would be overly ambitious to assume that students transition directly from 'Feel' to 'Do' over the span of five academic years. This implies that a more balanced distribution of the four components across all academic years may prove advantageous. It is important to note that this is not a recommendation; rather, the aim is to demonstrate that this analytical approach provides an opportunity to critically reflect on the course content and its alignment with the teaching philosophies.

Another notable finding of this study is that the SLOs predominantly target learners with the 'Converger' learning style (Think + Do) across all academic levels. Kolb's model, suggests that architects are typically classified as 'Accommodators,' a group characterized by their integration of both the 'Feel' and 'Do' components. Yet, the SLOs analyzed here emphasize the 'Think' and 'Do' components, which align more closely with the 'Converger' learning style. This may be seen as advantageous, given that 'Convergers' tend to excel in fields that emphasize technological application. As new and emerging technologies increasingly shape the field of architecture, the 'Converger' profile could become a more accurate representation of future architects. However, a key limitation is the diminishing emphasis on the 'Feel' component, which is traditionally associated with creativity. This reduction in the 'Feel' component over time suggests that the SLOs may not adequately prioritize creativity, particularly as students progress through their academic careers. This finding supports earlier discussions in the literature, which contend that SLOs in creative disciplines may inadvertently marginalize creativity by focusing primarily on outcome-driven, process-oriented learning. However, as previously noted, these findings are not intended to make any critique of the current set of SLOs of the school. This research seeks to illustrate that these kinds of findings can potentially contribute to the development of teaching philosophies or modifications in the student intake system.

6. Conclusion

Course content is of paramount importance to an institution, and its alignment with the school's philosophy is a critical consideration. However, analyzing the entirety of the course content can be overly subjective or broad. This study hypothesized that Student Learning Outcomes (SLOs) serve as a representation of the course content, as they function as measurable goals against which the alignment of the course content can be assessed. Then it revealed a method of investigating the SLOs by using Kolb's Learning Style Inventory (KLSI) as a tool. Investigating the Architectural Design studios, it showed its potential to detect certain inclinations of the SLOs. Depending on the university's policies, the method used in this research can provide a quick tool for gaining insight into the philosophies through the lens of the SLOs.

While other tools could be used to analyze course content, and alternative frameworks beyond the SLOs may be applicable, this research focuses on the development of a specific methodology.

Over time, comparisons with other methods that may be developed will determine whether this approach is more effective or widely accepted.

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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