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Design Thinking As A Viable Pedagogical Tool For Technical Student Training

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Abstract
This research explore the applicability of design thinking to the art of teaching and learning with a primary goal of boosting better understanding of course materials by student and increased multi-disciplinary learning with a thriving innovative approach to creative problem solving, the overall goal is to afford students a deeper meaning and stronger essence of education and to approach problems creatively, collaborate with peers, and develop a deeper understanding of technical concepts, sampled of 250 students from the school of which 10% of the student of this target population was selected after being assessed on the average impact on learning using the four (4) selected method of teaching , point bi-serial correlation method was used for the text,the average score of student was tagged (X) while the performance level was tagged (Y), this approach helps students develop essential skills such as critical thinking and problem-solving, the PBL has the highest average score (89.25), indicating it's the most effective method based on this data set.

Keywords: *Design Thinking, bi-serial correlation, pedagogic, multi-disciplinary, and innovative practice,*

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I. Introduction

Design thinking is an approach used for practical and creative problem-solving. It is based heavily on the methods and processes that designers use (hence the name), but it has actually evolved from a range of different fields—including architecture, engineering and business. Design thinking can also be applied to any field; it doesn't necessarily have to be design-specific, as already mentioned, the Design Thinking process is progressive and highly user-centric. Before looking at the process in more detail, let's consider some principles of Design Thinking(Isaksen & Akkermans, 2011)

Purpose Of Design Thinking: Now we know more about how Design Thinking works, let's consider why it matters. There are many benefits of using a Design Thinking approach—be it in a business, educational, personal or social context, first and foremost, Design Thinking fosters creativity and innovation Meepian, A & Wannapiroon, P. (2013). As human beings, we rely on the knowledge and experiences we have accumulated to inform our actions. We form patterns and habits that, while useful in certain situations, can limit our view of things when it comes to problem-solving. Rather than repeating the same tried-and-tested methods, Design Thinking encourages us to remove our blinkers and consider alternative solutions. The entire process lends itself to challenging assumptions and exploring new pathways and ideas. Design thinking is often cited as the healthy middle ground of problem-solving—it is not steeped wholly in emotion and intuition, nor does it rely solely on analytic s, science and rationale; it uses a mixture of both. Another great benefit of Design Thinking is that it puts humans first. By focusing so heavily on empathy, it encourages businesses and organizations to consider the real people who use their products and services—meaning they are much more likely to hit the mark when it comes to creating meaningful user experiences *Ayala-Altamirano, et al. (2020)*. Students are besieged with a lot of issues that beclouds their mind such a manner that renders the traditional teaching methodology ineffective and Poor or totally non-existence of tools and equipment for practical aid under learning of Course materials that lead to breads of poor graduates with no expertise and entrepreneurial mind set . The most popular teaching methods have evolved over time, but here are some of the widely used methods throughout history and into modern education:

Lecture Method: This is one of the most traditional and common methods, It involves the teacher delivering content to students, often in a one-way communication format, where the teacher speaks and students listen or take notes,the lecturing method of teaching is one of the oldest and most traditional approaches used in education. It involves a teacher presenting information to a group of students in a structured manner, usually through spoken words, visual aids, or multimedia. The goal is to convey knowledge, introduce new concepts, or explain complex topics. In a lecture-based classroom, the teacher takes the central role in disseminating information. The teacher

speaks or presents material, while students listen, take notes, and absorb the information, The focus is primarily on what the teacher knows and aims to impart, rather than on student-led discovery or collaboration and also structured Presentation are usually well-organized, with the teacher having a clear outline or agenda to guide the session. . This one-way nature can limit student interaction but is often seen as efficient for delivering large volumes of information in a short amount of time. Since students are largely passive, they may lose focus, become bored, or struggle to maintain attention, especially in long sessions, Lectures typically offer limited opportunities for student interaction, collaboration, or feedback. Without active participation, students may find it hard to engage with the material at a deeper level and lack of Professionalization

Teacher- Centered Method : This is a teacher-centered method where the teacher provides clear, structured, and detailed instructions to guide students through a learning task. This method often uses repetition and practice, it focuses on explicit teaching, where the teacher takes a leading role in presenting content and guiding students through learning tasks step by step *Crilly, N., et al. (2017*. The method is particularly effective for subjects or skills that require mastery of foundational concepts before progressing to more complex material, the teacher is the primary source of knowledge and plays an active role in guiding students through the learning process. The teacher is responsible for presenting the material, providing clear instructions, and modeling behaviors or skills,. the teachers break down complex concepts into manageable parts and explain each one in simple, understandable terms. Instructions are direct, and there is little ambiguity in what is expected from the students, It follows a structured sequence where concepts are taught in small, logical steps. The teacher introduces a topic, demonstrates the concept, practices it with the students, and then provides opportunities for students to practice independently. This progression ensures that students master foundational concepts before moving on to more challenging material,the method often uses techniques like questioning, prompting, and re-explaining to ensure that all students are following the lesson and also continuous formative assessment is a core component of Direct Instruction. Teachers regularly assess students' understanding of the material through questioning, quizzes, or brief exercises. Immediate feedback is given to students, which helps them correct mistakes quickly and reinforces correct understanding, teacher-centered method of teaching that focuses on explicit, step-by-step instruction and mastery of content. It is especially useful for teaching fundamental skills and knowledge in a structured environment. However, it may not be as effective for fostering higher-order thinking, creativity, or independent learning. The success of direct Instruction depends on the teacher's ability to manage the lesson structure, provide clear explanations, and engage students in active practice. When used appropriately, it can result in a high level of student achievement, particularly for basic skills and content mastery.

Inquiry-Based Learning (IBL) is a student-centered teaching method that encourages active learning through questioning, exploration, and critical thinking. Rather than the teacher directly providing answers, students are guided to ask questions, investigate, and construct their understanding of a subject. It's rooted in the idea that learners learn best when they are actively involved in their learning process in this approach the focus shifts from the teacher as the sole provider of information to the student as an active participant in their learning journey. The role of the teacher is to facilitate, guide, and support students as they explore and investigate topics, this process begins with questions — either posed by the teacher or generated by the students themselves, these questions often emerge from students' natural curiosity or from real-world problems. IBL encourages students to not only find answers but to analyze, evaluate, and think critically about the information they uncover. Students are expected to synthesize their findings, test hypotheses, and make connections between concepts. The process often involves refining the initial questions and revising hypotheses as new information is discovered It also foster students collaboration, discuss their findings, and share ideas, this collaborative environment helps build communication, teamwork, and social learning skills, as students learn from each other and offer different perspectives, some students may dominate the inquiry process that is uneven Participation , while others may be passive or reluctant to engage. It can be challenging for teachers to ensure that all students are actively involved in the learning process and assessing inquiry-based learning can be difficult, as students' work is often open-ended, and the learning process is more individualized. since inquiry-based learning is often open-ended, students might veer off topic or become unfocused. Teachers need to monitor and guide students effectively to ensure they stay on track while exploring their questions. Never the less Inquiry-Based Learning (IBL) is a powerful teaching method that fosters deep, active learning through exploration, critical thinking, and problem-solving. By emphasizing the student's role in posing questions, conducting investigations, and drawing conclusions, IBL helps students develop essential skills for lifelong learning. While it presents challenges, such as the need for careful teacher guidance and time investment, the benefits of fostering curiosity, independent learning, and critical thinking make it an invaluable approach, especially in subjects that encourage discovery and exploration.

Project-Based Learning (PBL): This is an instructional approach that emphasizes active learning through the completion of real-world, long-term projects. Unlike traditional methods that focus on short-term tasks or rote memorization, PBL encourages students to work on a complex, open-ended problem or question over an extended

period, promoting collaboration, critical thinking, and the application of knowledge. The focus is on creating a tangible product or solution, which students then present or share with a wider audience.some of the Key Characteristics of Project-Based Learning (PBL) are Student-Centered Approach which take on the central role in their learning journey Crilly & Cardoso,(2017). The teacher acts more as a facilitator or guide, helping students navigate the project, solve problems, and reflect on their progress. Students are responsible for managing their time, researching, and making decisions about how they will approach the project one of the primary goals of PBL is to connect learning to real-world problems, challenges, or questions. The projects often involve issues or situations that students might encounter outside of school, making the learning experience more meaningful and applicable. Projects could be community-based, interdisciplinary, or related to global challenges, allowing students to see the relevance of their work beyond the classroom, PBL method begins with an essential question or problem that prompts inquiry and investigation. Students are encouraged to ask questions, conduct research, gather data, and analyze information as they work toward solving the problem or creating the final product. This process involves critical thinking, creativity, and collaboration, as students explore different approaches to solving the problem or answering the question, some of which are,

- **Collaboration**: PBL is often collaborative, with students working in teams to accomplish a common goal. This promotes communication, teamwork, and shared responsibility. Collaboration also encourages students to learn from each other, exchange ideas, and improve their problem-solving skills. Working in teams also reflects the collaborative nature of many real-world tasks, such as working in the workplace or addressing societal issues.
- **Active Learning**: PBL involves hands-on, practical learning. Instead of passively receiving information, students engage actively in applying what they've learned to real-world contexts. This approach allows students to gain deeper understanding and develop skills that are valuable in both academic and real-life settings.
- **Presentation and Public Sharing**: At the end of the project, students are typically asked to present their findings, solutions, or creations to a broader audience, which could include classmates, teachers, parents, or even members of the community. This helps students develop communication skills and take pride in their work. Public presentations also emphasize accountability, as students are expected to communicate their work clearly and justify their decisions.
- **Reflection**: Reflection is an essential part of PBL. Students are encouraged to reflect on their learning, the project process, and their individual and group contributions. Reflection allows students to assess what worked, what didn't, and how they can improve in future projects.Teachers also reflect on the project and its outcomes, evaluating student progress and determining how the project could be improved for future cohorts.

Statement Of The Problem

The phrase garbage in garbage out is common , however when it comes to technical education , our observation is that "Nothing is even going in", the number of enrollment and retention into core technical courses is abysmally low , and therefore to change the narrative locally , hence project like this is critically needed.

1, Student are besiege with a lot of issues that becloud heir minds in such a manner that renders the traditional teaching methodology ineffective

2, Different student possess different learning habits and curve but again , the traditional methodology does no take his into account neither does I find was o circle back and carry every/ mos student along

The Objectives Of This Study:-

1. To add value to the art of teaching and learning for increased student engagement enrolment number
2. To produce workable result , concepts and program , extendable to other higher learning institutions
3. To improve he quality of polytechnic graduates , build proactive tutors and boost the ingenuity of tech student for higher productivity
4. To provide a scheme that promote a more interactive, multi-disciplinary training and learning environment
5. To introduce a more practical learning for more and active retention of concepts students
6. To allow a more exploratory learning where student are no instantly graded fail marks but engage in discussion for them to known better
7. To introduce a more dynamic learning ha caters for divers individual learning needs and habits.

In a traditional teaching scenario,the teacher directs students to learn through memorization and recitation techniques.This has been a workable method over decades.However, in recent years,educators have identified different paradigm of learning and teaching method

II. Literature Review

As the name suggests, solution-based thinking focuses on finding solutions; coming up with something constructive to effectively tackle a certain problem. This is the opposite of problem-based thinking, which tends to fixate on obstacles and limitations. A good example of these two approaches in action is an empirical study

carried out by Bryan Lawson, a Professor of Architecture at the University of Sheffield. Lawson wanted to investigate how a group of designers and a group of scientists would approach a particular problem. He set each group the task of creating one-layer structures from a set of coloured blocks. The perimeter of the structure had to use either as many red bricks or as many blue bricks as possible (we can think of this is as the solution, the desired outcome), but there were unspecified rules regarding the placement and relationship of some of the blocks (the problem or limitation). Design thinking is acknowledged as a thriving innovation practice plus something more, something in the line of a deep understanding of innovation processes (Thienen, Clancey, Corazza, & Meinel, 2018). Design thinking will create some other thinking such as creative thinking, mathematical thinking and so on. While problem-solving abilities in mathematics are essential for success in the twenty-first century, many learners who struggle with mathematics do not develop these skills throughout their primary grades.

Freiman, Polotskaia, & Savard, (2017); . From the students' view, especially in primary school students, nowadays it is indispensable to ensure that our country is always moving forward in the era of globalization.

Cynhian el, at. (1994) States that students in elementary school were able to pick their most innovative ideas , this implies that students are frequently encouraged to come up with various innovative ideas to address an issue instead of engaging in procedures that need both divergent and convergent thinking, such as fact gathering, problem solving, and solution seeking

Van Hooijdonk et al. (2020) did a literature review on creative problem solving in primary education, looking at the function of fact seeking, problem solving, and solution finding across problems. According to their findings, it is useful to use scores as the number of various knowledge aspects and the quality of the recognized problem when working with primary school children, especially when seeking for more and unique ideas before engaging in: fluency, originality, completeness, and practicality. However, limited research has been conducted by using systematic literature review (SLR) in design thinking.

Meepian, A & Wannapiroon, P. (2013). in their work they explicitly how the confidence instilled in pupils by Design Thinking during the creative process encourages them to push the boundaries of their creativity and invention

Wannapiroon, P. et al, (2008) in his work show that Design Thinking is useful in solving open and complex problems. Design Thinking helps to develop creative confidence among individuals to help them develop a new idea. Every student or designer should attain such confidence to help them engage successfully in the creative process of designing. More importantly, when used in the creative process, Design Thinking has been shown to have a significant beneficial influence on an individual 's desire

According to Rauth et al., (2010), Design Thinking is a structured way to help produce and develop ideas since its structured approach offers designers creative confidence.

Edward Allen , L el , at (1967) facilitates team-based learning, which supports the practice and holistic modalities of constructive learning in any project assignments. Cooperation and various individual views increase learning through teamwork, which is one of the essential pillars of Design Thinking.

According to Callahan et al. (2019**)**, using Design Thinking in the design classroom teaches undergraduates the value of idea generation and critical thinking. Design Thinking aided the pupils' creative process, allowing them to think in new ways. Developing creative thinking abilities in design students has proven to be a difficult undertaking for many design educators .

Crilly & Cardoso,(2017). show that Students may build creative abilities and creative confidence to solve issues successfully in a variety of scenarios by participating in the design thinking process. In a nutshell, design thinking has sparked students' imaginations and increased their creativity, as well as motivating them to design, solve problems, and think creatively. The goal of this project includes exploring the applicability of design thinking to the art of teaching and learning with a primary goal of boosting better understanding of course materials and afford a deeper meaning and stronger essence of education for Delta State Polytechnic, Ogwash- uku.

III. Research Methodology

The survey sampled of 250 students of which 10% of the student of this target population was selected after being assessed on he average impact on learning using the four (4) selected method of teaching . The point bi-serial correlation method was used to measure success versus failure and Percentage response, the average score of student was tagged (X) while the performance level was tagged (Y)

$$h_0 = r\ is\ not\ significan$$
$$h_1 = r\ is\ significant$$

The bi-serial correlation equation is given as

$$r = \frac{S\rho}{\sqrt{SS_x\ SS_Y}}$$

$$S\rho = \sum XY - \frac{\sum(X)\sum(Y)}{n}$$

$$SSx = \sum X^2 - \frac{(\sum x)^2}{n}$$

$$SSy = \sum y^2 - \frac{(\sum y)^2}{n}$$

the ex for significance of r

$t_c = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$ *with* $_{\alpha/2.n-2}$ *where* $\alpha = 0.05$

IV. Result And Discussion Of Findings

X	*Y*
60	*1*
50	*1*
20	*0*
40	*1*
10	*0*
10	*0*
20	*0*
30	*0*
10	*0*
60	*1*
35	*0*
45	*1*
37	*0*
33	*0*
28	*0*
22	*1*
30	*0*
70	*0*
80	*0*
50	*0*
65	*1*
75	*1*
80	*1*
70	*1*
50	*1*
23	*1*

$$\sum y = 13, \quad \sum x = 1080, \quad \sum x^2 = 58626, \sum xy = 800,$$

$$S\rho = \sum XY - \frac{\sum(X)\sum(Y)}{n}$$

800 - $\frac{1080-13}{25}$

238.40

$$SSx = 58626 - \frac{(1080)^2}{25}$$

= 11970

$$SSy = 13 - \frac{(13)^2}{25}$$

= 6 .24

$$r = \frac{238.40}{\sqrt{11970 \times 6\ .24}}$$

= $\frac{238.40}{273.31}$

= 0.87

$$r^2 = (0.87)^2 = 0.76$$

Implications (i) $r = 0.87 \Rightarrow$ *here is a* 87% *positive correlation between the teaching method and student performance*

(ii) $r^2 = 0.76 \implies$ *here is a 24% (100-76)% of variability in difference in teaching methods*
(iii) $t_{\alpha/2,n=2} \Rightarrow t_{0.025,23=\ 2.07}$

$$t_c = \frac{0.87\sqrt{23}}{\sqrt{1-0.76}}$$

$= \frac{0.87\times4.8}{0.49}$
= 8.53

$$t_{\alpha/2} = (2.07)$$

The correlation coefficient I.e the strength of relationship between the student performance and teaching method is significant

Percentage response Chart

	Lecture	***project base***	***IBL***	***Teacher centre***
Assignment response rate	*95*	***86***	***92***	***92***
Class Participation	***64***	*96*	*78*	*68*
Work without supervision	*98*	*79*	*94*	*76*
Field work	*62*	*96*	*76*	*90*
Total	*319*	*357*	*340*	*326*
Average return rate	***74.75***	***89.25***	***85***	***81.5***

Averages:
- Lecture: 79.75
- Project-Based Learning: 89.25
- Inquir base Learning: 85
- Teaching: 81.5

Key Insights:
- Project-Based Learning (PBL) has the highest average score (89.25), indicating it's the most effective teaching method based on this data set.
- IBL comes next with an average of 85, which suggests it's also highly effective.
- Teaching is in the middle (81.5)
- Lecture has the lowest average (79.75), indicating it might not be as effective in engaging students or fostering the same level of performance as the other methods.

This comparison clearly highlights the strength of Project-Based Learning and Inquiry Base in driving better performance.

Summary Comparison: Highest to Lowest:
1. Assignment Response Rate (91.25)
2. Work Without Supervision (86.75)
3. Field Work (81)
4. Class Participation (76.5)

Here's a detailed comparison of the performance across the four categories based on the average scores:
1. Assignment Response Rate **(91.25)**

Highest performing categor**y**: This category has the highest average score, indicating that most individuals performed well on assignments. The high score (91.25) shows strong engagement and effective completion of tasks that were likely clear and well-structured.

Analysis: The results suggest that students or participants were able to manage and complete their assignments successfully, possibly due to well-defined expectations or a supportive environment.

2. Work Without Supervision **(86.75)**

Second-highest performance: While slightly lower than the assignment response rate, the performance in this category is still strong. The average of 86.75 indicates that participants are capable of working independently without much guidance or supervision.

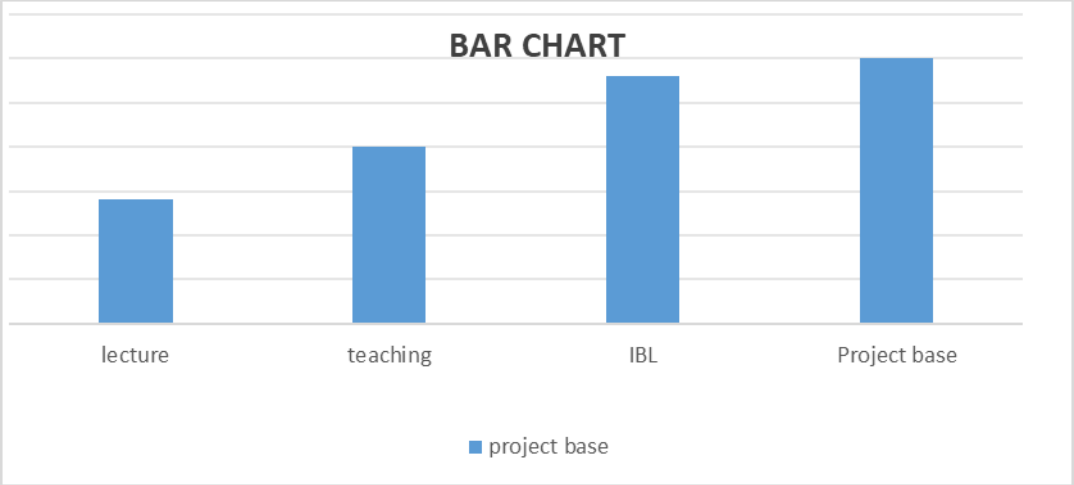
Analysis: This suggests that individuals are developing self-motivation and autonomy, and the tasks in this category may not require as much oversight to complete effectively.

3. Field Work **(81)**
Moderate performance: The average score here (81) is solid, but lower compared to both the Assignment Response Rate and Work Without Supervision. Field work often involves real-world application, which can be more challenging and may require additional resources or external factors that affect performance.

Analysis: The relatively good performance here (81) shows that participants can apply what they've learned in a practical setting, but there might be room for improvement, especially in areas requiring greater attention or resources.

4. Class Participation (76.5):
Lowest performance: The lowest average score is in Class Participation, with a score of 76.5. This could reflect a lack of engagement, fewer opportunities to contribute, or external factors such as classroom environment or personal confidence levels.

Analysis: Class participation often involves active discussions, contributions, and engagement with the subject matter in real time. This score suggests that participation levels may need to be increased, possibly by fostering more inclusive and interactive classroom strategies.



V. Conclusion:

There's a clear strength in Assignment Response Rate and Work Without Supervision, indicating that participants excel at completing tasks when given clear instructions and independence. Field Work is performing decently, though there may be challenges related to real-world application or external factors. Class Participation has the most room for improvement, suggesting that increasing student engagement or improving class dynamics could be beneficial. In conclusion project-Based Learning (PBL) is an innovative, engaging, and effective approach to technical education that helps students develop critical 21st-century skills such as collaboration, communication, creativity, and problem-solving by working on real-world projects, students gain deeper understanding and mastery of the subject matter while learning how to apply their knowledge in meaningful ways. Although PBL presents challenges, such as time constraints and resource requirements, its emphasis on active, hands-on learning and real-world relevance makes it a powerful method for fostering deeper technical student training

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