DESIGN THINKING AS AN EFFECTIVE TOOL FOR ARCHITECTURAL PEDAGOGY: Challenges and benefits for Ghanaian schools

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Abstract: Design Thinking is a methodological advent to design, acknowledged in many design schools, and marketing establishments. This design approach, although recognized as efficient in several business avenues, is not noticeable in architectural pedagogy in Ghana. This paper employs an exploratory study, aimed at identifying the current concepts used in architectural teaching and learning, as well as challenges encountered by students who refer to the Design Thinking approach. Ghanaian students will also be enlightened about its potential to significantly improve creativity and ingenuity. Considering reviewed literature reveals diminutive application of Design Thinking process in architectural pedagogy, this study recommends further research in the adaptation of the Design Thinking methodology in architectural design. The pragmatic philosophical worldview is what drives my research. This is because it is concerned with applications and solutions to problems. Instead of focusing on methods, researchers emphasize the research problem and use all approaches available to understand the task.

Subjects: Design History; Product Design; History of Art & Design

Keywords: Design Thinking; architectural pedagogy; architecture; Ghana

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PUBLIC INTEREST STATEMENT
The desire of every designer is to see the complete satisfaction of their products by the end users. Yet many designs have failed this expectation due to lack of holistic and continuous engagement with the intended users on their needs and aspirations. Design thinking seeks to remedy this gap in the design process with the basic concept of achieving an inclusive end product meeting the needs of all intended users. Its use has not been very familiar in many schools of architecture, especially sub-Saharan Africa. This research thus sought to investigate the current teaching concepts and challenges of the users of design thinking in architectural education in Ghana. The study revealed that though many appreciated the importance of adopting design thinking being employed in architectural teaching methods much sensitization is needed for its general acceptability.
1. Introduction
Developing innovative ways in the 1950s as well as new approaches to design in the 1960s led to Design Thinking as an appropriate problem-solving mechanism (Arnold, (2016) [1959]). One of the first authors to use the term Design Thinking was John E. Arnold. Design Thinking’s first conception is to yield novel functionality. These are remedies that fulfill an innovative need or strategies that satisfy an archaic requirement in an unusual way, a solution’s higher performance levels, lower cost of production or enhanced salability. In other words, the solution for one problem can be used to solve a different problem. According to this early concept, “Design Thinking” thus covers all forms of product innovation, particularly incremental innovation and radical innovation (Arnold, (2016) [1959]). Incremental innovations refer to minor improvements made to upgrade a company’s existing products. Radical innovations are invention that supplant an already existing business model. Arnold proposes a measured approach that indicates that project teams need to take opportunities in all five Design Thinking aspects (Arnold, (2016) [1959]). The education of design is often a vital expression as well as the effective methodology can and must be implemented and discussed during each level, from instructional organizing to classroom tactics.

Design Thinking, from a designer’s view is a human-centered technique to creative invention that combines customer’s needs, contingency to technology, and the requisite for business success. (Brown, 2008). Design Thinking is a conscious intellectual activity, which involves strategic and applicable processes from which designer’s develop ideas. Most developed ideas (proposals for new commodities, buildings, machines, to name but a few) and interesting aspects of Design Thinking have been identified through research across numerous design disciplines. (Kolko, 2018). Design Thinking is a repetitive procedure that seeks to understand user’s need, challenge assumptions, and reexamine cases in an endeavor to correlate other optional strategies and solutions that usually may not be instantly apparent with the initial level of comprehension. Again, Design Thinking delivers a solution-based strategy to problem solving. It is a method of thinking and working and the compilation of hands-on procedures. (Dam & Siang, 2018)

Some experts conclude that there is no concept of Design Thinking that is widely accepted, and some suggest that we should not look for one. As an alternative, emphasis should be placed on the location and purpose the concept used in pedagogy, and the meaning given to the concept. (Johansson-Sköldberg et al., 2013) Design Thinking features core abilities such as resolving “ill-defined”, also known as “wicked problems”, adapt to “solution-focused” strategies, use of “abductive” and “productive” reasoning and also employ “non-verbal graphic display”. “Wicked problems” pertaining to Design Thinking refer to problems that are crafty and fluid, whereas for “well-defined” problems, the solution is clear and obtainable through the application of technical knowledge. (Rittel & Webber). Architects employed the use of “solution-focused cognitive strategies”, distinct from scientists who chose “problem-focused strategies” (Bryan Lawson, 1979). There are five stages involved when using the Design Thinking approach. These are Empathize, Define, Ideate, Prototype and Test.

The first step, “empathize” centers on understanding the problem from a consumer standpoint. Alternatively, this process aims to grasp and comprehend the user’s needs. (Wrigley et al., 2017) The second step, “define” is a reflection of the identified problem. It seeks to establish a plan on how to address the problem. (Wrigley et al., 2017) The third, “ideate”, utilizes a creative mindset to determine innovative solutions. Research is conducted at this stage. Solutions and details are thoroughly brainstormed by the designer. (Wrigley et al., 2017) Secondly a prototype is created, whilst making sure the opinions of the end user is accommodated. In the last step, the prototype is reviewed and feedback from users is noted. Adjustments may be made at this stage and a final solution will be presented to the user or the client. The process needs to be repeated in a cyclical manner rather than linear for a successful result. (Wrigley et al., 2017)
2. Concepts of design thinking

The practices, methods and mindsets emphasized today are called “Design Thinking”. As discussed, advocates of Design Thinking only performed a successful job of grouping and teaching the acquired knowledge for years, if not decades of design practice into concept suitable for teaching others other than architects.

Many versions are in use today in the design process. Usually, they have at least three to seven stages or phases. Fortunately, all variants are similar, and represent the same core values. The Design Thinking Model (Hasso Plattner Institute of Design at Stanford, n.d.) model proposed by the Hasso Plattner is a preferred approach. This is due to its forefront application and teaching of Design Thinking. According to Plattner et al. (2009), the Design Thinking process consists of five process steps: empathize, define, ideate, prototype and test.

2.1. Empathize

Empathize reinforces the need to understand the situation from the end-user perspective. Fundamentally, the first step aims to grasp the situation as a whole to better comprehend what is needed. The very first stage in the Design Thinking process gives us an opportunity to immerse our assertions and indulge ourselves in the event of a problem that we are trying to remedy. The specific issue determines who could be useful, and the remedy, as well as which professionals could help shed light on how the issue is being solved at present. (voltagewelding, 2019)

2.2. Define

Define is the step in which the documentation collected from the empathization phase is analytically verbalized and defined. This process enables reflection of the problem implemented as a way of creating a plan or acknowledging the need for a remedy. (Brown, 2009). This stage is designed to translate that necessity into a standard benchmark. In this phase, we integrate and assess the research in order to draw knowledge from available data. The subsequent research problem should be recorded in human-centered contexts instead of concentrating on strategic objectives. (nngroup.com, 2019)

2.3. Ideate

Now, because the problem is obvious, one needs to come up with ideas ways to tackle those immediate needs. The stage of thought marks the transformation from problem identification to solution discovery. (Brown, 2008). Ideate phase in the development uses a unique and productive mentality to ascertain inventive solutions. The solution is created in this phase, and study was carried out on how to generate actuality from that image. This is the phase of the process that allows the subconscious to form the solution (T. Kelley & Litman, 2001).

2.4. Prototype

Prototype is the phase in which tangible solution is erected. This step applies a creatively formed idea—thus something authentic, tangible and real. Prototyping allows ideas to be translated into tangible form in order to present the design to clients and receive feedback. This testing starts with a simple version of the design and gradually reinforces it as feedback is received. The solution is thus developed together with the client (Plattner et al., 2004).

2.5. Test

Test is the final step in the Design Thinking phase. The prototype is reviewed here, feedback is collected, and changes may be made. This phase entails completing the design that will ultimately be offered to the end user. The test stage consists of detailed, tweaking and monitoring to prove the prototype meets the user's needs. The test step provides a solution to the initial problem, and the process needs to be repeated until the solution is perfect and exact (Plattner et al., 2004). Returning to the first step of the process and reiterating each phase may therefore be needed to accomplish a satisfactory outcome. This framework should be seen as gradual in nature, allowing the layout to focus on end-user needs. As an architect, this process can prove useful by ensuring that all client needs are met and exceeded.
Thus, it can be seen from the above discussions that the concept of Design Thinking is a human centered design process that utilize evidence of real use and need of a product from the consumer’s point of view rather than the thinker’s point of view. The constant interaction of the various processes also guides the design of spaces making room for future needs of users. Design Thinking in architecture is becoming very important to the delivery of adaptive architecture instead of beautiful designs that do not meet the needs of users. There is the need for schools of architecture to embrace this concept in the teaching pedagogies in order to deliver sustainable, pragmatic and inclusive designs.

Ghana, a country in west Africa, with a population of about 31 million has two schools of architecture has seen architectural education since 1957, when architecture was introduced in the country. The only public architecture school is at Kwame Nkrumah University of Science and Technology, Kumasi (KNUST), Kumasi and produces over 90% of architects practicing in the country. The university is one of the top 20 universities in Africa. It is thus seen as one of the leading examples that many African countries and others look up to for innovation and leadership. The school is one of the few architectural institutions on the African continent with full accreditation from the Commonwealth Association of Architects and was born out of the British system of architectural education and practice. The introduction of Design Thinking into the teaching of studio in the schools of architecture will bring innovation into the traditional teacher-oriented form of instruction at the studio through creative and critical thinking skills of students that ultimately deliver pragmatic solutions for the end user.

3. Architecture students’ concept of designing
An example of pedagogy in school of architecture in KNUST is the rural survey students undertake in the 2nd year of architecture school. During this period, students are billeted out to rural villages, where they undertake a settlement survey and develop plans for public facilities based on an assessment of local needs. They are tasked to document the existing activities and needs of the community. These may include residential, infrastructure, recreation, culture, commercial, industrial and other essential needs of the community. They empathize with the residents during discussions and interviews and are able to define basic needs for the locals. Back at school, students are grouped and tasked to propose design solutions to unique problems and challenges faced by the locals in their present operations and functions, while taking into consideration their future needs. These design solutions must be very innovative, iconic, sustainable and appropriately fit the context. Prototypes of these solutions, popularly known as physical models are created to appreciate its feasibility.

To be meaningful, the department of Architecture, KNUST believes that analyzing requirements must go beyond simple economic and social research. (Barac, 2012) It must be incorporated in an architectural conceptualization of the design response agenda, which prioritizes three components: culture, climate, and construction, according to the KNUST pedagogy.

4. Methodology
In order to understand the ineffective use of Design Thinking in architecture, it is essential to establish the design pedagogy used in architecture schools in design processes. This was carried out through distributing questionnaires to randomly sampled students. This is generally known as the mixed-method approach. A convenient sample of 50 subjects was selected from the institution. All subjects were architecture students of KNUST. The qualitative approach included observation of the design teams in the architectural department in order to understand the approaches used by students in design. Again, purposively selecting KNUST as a case study will bring to the fore the effective application and outcome of Design Thinking for other schools of architecture on the continent to learn and apply.

5. Design thinking preambles
Anything that a design thinker does is based on an attempt to better understand the human being. In fact, the term human-centered design can be used almost synonymously with Design Thinking. This attitude of being mindful of people has at least two sides. (New York: HarperBusiness, 2015): the focus
on the team on the one hand, and the focus on the target audience or user on the other. In the methodology, some preambles were deduced from the varying definitions of Design Thinking.

5.1. I prefer coming up with new ideas than evaluating existing ones …
In general, Design Thinking requires the team members to take an innocent perspective in order to be able to learn something new. (Gekeler, 2019)

5.2. I can readily see other people’s situation from their point of view …
Additionally, a true design thinker would always bring on other perspectives during a project, e.g., through interaction or even co-creation with the target audience, experts or other people who can contribute their views and ideas to the project. (Gekeler, 2019)

5.3. I am confident every problem has a solution …
Kelley and Tom Kelley describe Design Thinking as “a way of finding human needs and creating new solutions”. Usually, the little word “new” carries a lot of importance whenever Design Thinking is used. (Gekeler, 2019)

5.4. I only propose solutions when I am certain …
The reason for many organizations to consider an approach such as Design Thinking is the need for innovation. The problem here is that the team cannot know at the outset of a project exactly what the outcome will be. That actually is the whole point of the exercise. Design Thinking is a useful tool to assist in the design process in cases in which solutions need to be carefully unpacked, analysed and understood. It helps in cases in which solutions to problems may not be immediately obvious, and would benefit from multiple analytical viewpoints (Gekeler, 2019)

5.5. I visualize possibilities …
Visual techniques such as sketching can be used to gather emerging ideas and not fully formed. The images of these developing ideas can then be revisited later for refinement (Pfister & Eppler, 2012). Initial sketches provide a useful way for individuals to think through and flush out ideas (Bresciani et al., 2008; Craft & Cairns, 2009; Kavakli et al., 1998; Römer et al., 2000; Sachse et al., 2004; Schütze et al., 2003). Visually depicting ideas (which are the internal thoughts of individuals) allows them to be externalized (Heiser et al., 2004). This externalization moves an idea from abstract to concrete. Moving from abstract to concrete allows a solution to be further explored to determine weaknesses and experiment with improving the solution. In this way, visuals allow a solution to go through multiple iterations before being finalized.

5.6. Collaborating with others is essential …
Collaboration involves an understanding of human impact because it involve engaging with others. There is a level of risk taking involved when collaborating because one must be vulnerable in sharing ideas. These skills are each individually valuable; however, when these capabilities are fused, they become a superpower that enables creating solutions. The need for engaging with others is very much in line with literature describing Design Thinking as a collaborative process that takes place in the company of others (Avital et al., 2009; Seidel & Fixson, 2013).

6. Existing approaches in design
Around 2003/2004 Hasso Plattner, one of the founders of the software company SAP, read about David Kelley’s design school, which is connected to Stanford University in Palo Alto. Kelley used a process that he called Design Thinking to let students collaboratively work on problems that are not easily analyzed. Similar approaches and methods had been taught successfully around the world before, but usually to students who were aspiring to become designers themselves. At Stanford, Kelley invited students from all kinds of disciplines into what he called the d. school. He wanted to teach his students to become innovators rather than administrators in their respective fields and even across disciplines. The following meeting between Hasso and Kelley
accelerated the subsequent rise of Design Thinking. Hasso generously funded the d.school at Stanford, which since then has spread around the world from Potsdam, Germany, to Cape Town, South Africa, and then on to Kuala Lumpur, Malaysia, and Beijing in China. Other schools from various backgrounds are also introducing a design-thinking approach. (Kelley Kelley & Kelley, 2013)

In the course of these developments Design Thinking has evolved from a profession (traditional design) into a novel approach that helps people solve their respective challenges in a more creative, human-centred, collaborative, iterative and visual way, hence Design Thinking. ("Meado," 2016) There often is a discussion around how Design Thinking is to be done correctly. Many employees of the companies mentioned above say that Design Thinking is best done in a workshop format. If you ask members of design agencies or professional design teams within those organizations they strongly disagree and say that Design Thinking is rather embedded in their way of working, and might equally might not also happen in a workshop format.

The existing routine used in designing was obtained by asking question and rating them with the five-point Likert scale for designers to determine how often they used or didn’t use some approaches when designing. The responses were analyzed using the frequency charts tabulated in excel worksheets. The variables ranked 1 to 7 have means greater than 2.0 which is the mean population. Variables ranked 8 to 10 have means less than 2.0 which mean that most respondents either agree or strongly agree with those preambles. In short, the variables: “I sketch ideas …, I’m curious about how people are affected by issues … and every problem can be solved …” are preambles that are most recognized existing approaches in Design Thinking in pedagogy. Therefore, in ranking order it was found that ‘Difficulty in explaining using visuals …” was the most deficient approach in pedagogy whiles “every problem can be solved …” was the most used approach of Design Thinking in pedagogy as seen in Table 1 below.

| Table 1. Ranking of approaches of design thinking used in pedagogy |
|------------------------|---------------------|-----------------|----------------|------------------|
|                        | Mean               | Standard Deviation | Ranking | Sig. (1-tailed) |
| Difficulty in explaining using visuals | 4.1556             | 6.16794           | 1           | .006             |
| New ideas present too much risks | 3.4000             | 1.13618           | 2           | .000             |
| Other’s perspective confuses my thinking | 3.0889             | 1.18364           | 3           | .000             |
| I only understand with experience | 3.0667             | 1.09545           | 4           | .000             |
| I always follow a structured process | 2.6222             | 1.00654           | 5           | .000             |
| Have all facts before you begin work | 2.6222             | 1.00654           | 6           | .000             |
| Answers always lie in past works | 2.2222             | .84984            | 7           | .000             |
| I sketch ideas | 1.9333             | .83666            | 8           | .001             |
| Curiosity about how people are affected by issue | 1.8889             | .74536            | 9           | .001             |
| Every problem can be solved | 1.8667             | .96766            | 10          | .015             |
7. Challenges in the effective use of Design Thinking

The objective of the design-thinking approach is not necessarily to be more time efficient. Even with Design Thinking, things take their time. Due to its creative and structured approach, Design Thinking may help teams in starting small and circumvent obstacles, thus reaching the goal quickly. However, this requires a high level of self-discipline within a team. (Gekeler, 2019)

Participants in this process additionally described the danger of getting lost in the process and not finding your way out towards actually implementing the ideas. This is a problem that can be observed in many design-thinking teams. They get overly excited about having ideas and building prototypes, but then nothing really happens afterwards. Therefore, the expectation towards Design Thinking should be kept to a realistic level. It can inspire teams to have creative ideas. It can help teams to create innovative solutions to their respective problems, but it is not a guarantee for success. Again, you need discipline within the team to walk the walk and actually implement the ideas and concepts. Since Design Thinking (especially in the social sector) is highly self-driven with few resources, the team must take the lead and step out of their comfort zone in order to really take advantage of the methods and tools.

The variables ranked 1 to 8 have means greater than 1.5 which is the mean population. Variables ranked 9 and 10 have means less than 1.5 which means that most respondents either agree or strongly agree with those preambles. In short, the variables problem solving involves failed solutions and good solutions involve gathering ideas from others are critical preambles in the use of Design Thinking that are recognized in pedagogy.

| Challenges in Pedagogy                                   | Mean   | Standard Deviation | Ranking | Sig. (1-tailed) |
|----------------------------------------------------------|--------|--------------------|---------|-----------------|
| I prefer coming up with new ideas than evaluating existing ones | 2.5556 | .86748             | 1       | .000            |
| Test when solution is fully developed                     | 2.4222 | .94120             | 2       | .000            |
| I can readily see other people’s situation from their point of view | 2.2444 | .88306             | 3       | .000            |
| I am confident every problem has a solution                | 1.8889 | .61134             | 4       | .000            |
| I consider every information based on feedback             | 1.8889 | .61134             | 5       | .000            |
| I am eager to try new ideas                                | 1.8000 | .66058             | 6       | .004            |
| I visualize possibilities                                 | 1.6667 | .70711             | 7       | .121            |
| Problem solving is step by step                            | 1.6222 | .80591             | 8       | .315            |
| Problem solving involves failed solutions                  | 1.5778 | .58344             | 9       | .376            |
| Good solutions involve gathering ideas from others         | 1.4222 | .54309             | 10      | .342            |
8. Strategies for improving the effective use of Design Thinking

Design Thinking has many applications and it can successfully be applied in architecture. As described in the introduction, Design Thinking works best when the challenge to be solved is rather complex and allows for several answers. Through the process of Design Thinking a multidisciplinary team is empowered to work collaboratively, visually and to be compassionate with their target audience and their context. If that team has the right mindset, it will be able to develop solutions for the problems they are working on, which might be different from the ones they have had so many times before. In the social sector in particular, these solutions do not necessarily have to be big innovations. Sometimes even small changes or a new angle for applying decades-old knowledge can be just as effective. (Gekeler, 2019)

The sample size under study consisted of 45 respondents. The strategies presented are those with means above 1.5. Like the challenges, since the ratings 1 and 2 were categorized as strongly agree and agree respectively, Uo was fixed at an appropriate level of 1.5 (see for instance, Ahadzie, 2007; Ling, 2002). Thus, a strategy was considered significant if the rating was above Uo. It can evidently be detected from Table 4.5.1:1 that, I only propose solutions … had the highest mean, whilst collaborating with others is essential had the least mean. From the table, it can be observed that I only propose solutions …., has the highest mean score of 3.0667 and a high standard deviation of 4.66320. This shows that the students do not strongly support this strategy, and are not convinced this strategy may work, should it be implemented. The standard deviation of 4.67, shows that there is a significant variation in the results from the various respondents, as compared to other variables. Below, the ranking of the various strategies according to their mean values has been tabulated. Collaborating with others is essential …., has the least mean score of 1.6667 and a high standard deviation of 0.70711. This shows that the students back this strategy sturdily, and are convinced this strategy may work, should it be implemented.

| Strategy                                                                 | Mean   | Standard Deviation | Ranking | Sig. (1-tailed) |
|-------------------------------------------------------------------------|--------|--------------------|---------|-----------------|
| I only propose solutions when I am certain                              | 3.0667 | 4.66320            | 1       | .029            |
| It frustrates me to discover new information                            | 2.3778 | .98371             | 2       | .000            |
| Failed solution provides great opportunity                              | 2.0222 | 3.09317            | 3       | .264            |
| Problem solving is an iterative process                                  | 1.9778 | .78303             | 4       | .000            |
| Two steps back, three steps forward                                     | 1.9333 | .71985             | 5       | .000            |
| Considering new information                                             | 1.8889 | .68165             | 6       | .000            |
| Taking risks in trying something new                                    | 1.7111 | .54864             | 7       | .013            |
| I am primarily interested in learning                                   | 1.7111 | .58861             | 8       | .020            |
| When thinking of solutions                                               | 1.6667 | .67420             | 9       | .104            |
| Collaborating with others is essential                                   | 1.6667 | .70711             | 10      | .121            |
9. Conclusion and recommendation

The study concludes that the major challenge faced by designers are that, “they prefer coming up with new ideas”. Contrary to their practices, research encompassing teams and collaboration offers insight into the establishment of the suitable cooperative exploration team environment. (Katzenbock & Smith, 1993; Levi, 2014). The variable is seconded by “they do not follow a step-by-step approach when designing”, which also is not a very effective way of designing. Design Thinking is a human-centered innovative process to problem-solving that involves diverse justification, self-awareness, numerous ideas, prototyping, ambiguity, optimism, risk-taking and ineptitude-studying to come to a solution. (Boland & Collopy, 2004; Tim; Brown, 2008; Cross, 2011; T. Kelley & Littman, 2001; Liedtka & Ogilvie, 2011; Martin, 2009; Owen, 2005).

Today, our impact as designers and professionals is critical to our overall understanding of the Design Thinking concept (Johansson-Sköldberg et al., 2013)

One such method in the context of team building and corporate practices is the sprint used in scrum method, in which portions of a remedy are presented at a time, allowing remedies to transform as the remedy is developed and new information is collected. (Boland & Collopy, 2004) Among the many ranked strategies to improve the effective use of Design Thinking, the highest ranked was “obtaining new information for the design process”. Gathering information on how people are currently solving the problem provides clues on how to give a more innovative solution, and learning about frustrations with those solutions serves to identify unmet needs. (nngroup, 2019)

In summary, this research explored the challenges that disrupted the effective use of Design Thinking in architectural pedagogy. To identify the specific challenges, it was made a point to add on to the list of challenges obtained from literature. Benefits of Design Thinking and strategies to improve these challenges were also identified, with input from several architecture students towards the subject matter. This paper therefore recommends further research to assess how these challenges can be dealt with, to improve the use of Design Thinking in architecture schools.

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