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Review Article

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Design Thinking, a Novel Approach for an Effective and Improved Educational System–A Review

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ABSTRACT

The 21st century calls for improved technical skills and globally competitive caliber particularly among students to provide effective solutions for societal issues. This emphasizes the need to invent newer methods and techniques with a human friendly approach that is empathetically potent. Design thinking (DT) is one such scientific approach that helps one to create prototypes taking into consideration the creativity, visualization, design and redesign of things based on feedbacks, thus offering feasible solutions to any technical or socio-economic problems. Although many researches on implementation of DT strategies have been carried out globally as yet, little is known regarding how these techniques influence students' learning experience and their problem solving capabilities in educational scenario. This article provides an overview of information's collected from multiple data sources including organizational surveys, classroom observations showcasing the effectiveness of the application of DT approach for an improved educational system and organizational effectiveness.

Keywords: design thinking, creativity, complex problems, solutions, effectiveness

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INTRODUCTION

Design Thinking Process

Design thinking (DT) can be understood as a 'human-centered' approach to innovation that integrates human, business and technology factors in the problem identification and solving process (Boy, 2017; Brown, 2008; Lewis et al., 2020; Meinel & Leifer, 2011). It provides pragmatic tools and methods to explore, create and experiment with ways to transform human activity (Hoolohan & Browne, 2020) with inspiration, ideation and implementation as a culture. DT approach differs from traditional design techniques (Jones, 2017) in the way the skills associated with design thinkers are easily understood and accessible to untrained people as the emphasis remains on practical application of design principles and processes (Baker & Moukhliss, 2020). The DT tools are widely used by industrial and product designers. The traditional design process follows cycles of mutual alterations and adjustments between product specifications and solutions until a realistic solution is reached (Hatchuel & Weil, 2009). DT approaches have substantial overlap with traditional design; it calls for the invention of all new and best possible alternatives than one right way for a solution, yields multiple ideas that create better outcomes for organizations and the people they serve (Brown & Wyatt, 2010; Lawson, 2006; Peters, 2018). The key elements of DT include definition, observation, brainstorming, rapid prototyping, testing, implementation, and feedback (Ambrose & Harris, 2010; Baker & Moukhliss, 2020; IDEO, 2019; Nussbaum, 2009) with multidisciplinary collaboration and iterative experimentation to achieve desirable, user-friendly, socio-economically viable, and tangible solutions (Brown, 2009; Dorst, 2011; Dunne & Martin, 2006). Integrating this human centered creative problem solving approach, designers take on an additional role as design thinkers (Bennett et al., 2016). Lindgaard and Wesselius (2017) examined DT in relation to developments in cognitive science and embodied cognition and proposed that human centered feeling plays a role in both design and cognition.

Design Thinkers Attributes

Experienced designers posses *comprehensive understanding* and *evaluation* skills in addition to strong interpersonal skills which allow them to connect with people from different disciplines, collect feedback that should go hand in hand for innovative process (Bason, 2013; Cross, 2004; Owen, 2007) to enable them solve complex problems. Designers are solution focused, primarily keep the problem in mind, develop humility and 'an emotional connection' to the people involved in the process to gain mutual understanding, visualize human centric approach with empathy for the design process focusing on its specifics and are able to generate, synthesize and look at variety of solutions for the problem and finally narrow down the procedures and concepts to create a optimal holistic solution (Kolko, 2018; Lewis et al., 2020; Razzouk & Shute, 2012). Combined relationship of understanding of purpose and mode of operation of systems and DT play a vital role for designers to improve quality of human experience (Buchanan, 2019).

DT IN AN EDUCATION ENVIRONMENT

A large portion of the graduates from educational institutions were observed less industry ready causing great concern on the employability aspects. This led to the need for changes in educational design, the thought process and the importance of understanding of intellectual complexities (Dutson et al., 2013). Academicians, in the recent years have expressed interest in teaching engineering students to solve real world problems through design education (Dym et al., 2013). Unlike yesteryears, being successful today demands greater skills than that were needed before (Razzouk & Shute, 2012; Shute & Becker, 2010).

Owing to the valuable contributions made by DT in business and management, there is a growing trend seen in higher education institutions offering DT methodology and approach to business students, managers and executives (Glen et al., 2014; Martin, 2009; Matthews & Wrigley, 2017; Starkey & Tempest, 2009). In the DT approach (Bazylak & Wild, 2007; Brones et al., 2017), collection of feedback from the user remains a key characteristic element and perceived as a beneficial approach for the learners to incorporate it into any course in an accelerated manner which builds creative, critical thinking and complex problem solving skills that are in demand in today's world (Blizzard, 2013; Brown, 2008; Dym et al., 2013; Foster, 2019). The user-centered DT approach has been selectively applied to curricula over a wide range of engineering disciplines. It provides an accessible structure and habits of mind from a teaching team perspective that benefit teachers to think and navigate creatively in dealing with educational problems of practice (Henriksen et al., 2017; Laferriere et al., 2019).

There is a huge potential for researchers to conduct a wide range of experimental studies to examine the effect of DT variables on various learning platforms, their outcomes, and the nature of influence between an independent variable and a dependent variable on a particular domain. In any process the researchers modify the existing design based on feedback available, remove discrepancies and establish a solution which becomes a proper fit between the problem space and the proposed design solution (Braha & Reich, 2003). From the review of Research works conducted by universities, where students were exposed to DT in classroom situations, project expos and workshops proved the emergence of human-centered design (Matthews & Wrigley, 2017). Research suggests that the use of DT to solve problems may result in improvements in recognizing and taking advantage of opportunities and effecting change and innovation (Garbuio et al., 2018; Kurtmollaiev et al., 2018). Some studies combine social practice theories with design methods for enabling sustainable futures (Davies & Doyle, 2015; Hoolohan & Browne, 2020; Vihalemm et al., 2020).

Students as Design Thinkers

The DT skills of students and their competencies could be assessed by putting them in a suitable environment such as a project display or a game situation or a simulation kind of diagnostics by which the degree to which the skills are demonstrated could be assessed (Shute et al., 2012). DT supports students in developing critical thinking, logical reasoning and solve complex problems of the 21st century (Razzouk & Shute, 2012; Rotherham & Willingham, 2009; Shute et al., 2012). The learner-centered approach can help students build their confidence and enhance their interest in solving complex problems in all ways of their life (Dym et al., 2013, Gee, 2000). A national cross-sectional study measuring DT perceived ability among first-year and senior engineering students proved that first-year students scored significantly higher on DT scale than senior students (Coleman et al., 2020)

The conventional mundane educational practices typically adhere to archaic theories of learning and pedagogy leaving many students disengaged. Brones et al. (2017) observed an increase in the functionality of design outcomes with engineering students of a small sample size when they were taught with a DT approach. Inculcating the art of DT and multitasking into the classroom within students may better prepare them to deal with difficult situations and to solve complex problems in schools, colleges, careers, and in life in general. Teaching with this experimental approach amongst students produces more innovative, functional design outcomes in engineering capstone courses (Brones et al., 2017). Implementing the DT approach in the class room increases concentration and encourages divergent thinking when solving design problems (Coleman et al., 2020). The students' performance could also be inferred by feedbacks related to DT variables (Gee, 2000).

A serious concern among the colleges is that the undergraduate degree in engineering does not improve the divergent thinking ability within the students substantially (Bennetts et al., 2017). On the contrary, the leaders in business and industry maintain their interest in DT, academic discussions of the concept have become less common (Lindgaard & Wesselius, 2017).

DT APPLIED TO ORGANIZATIONS

With increased business competitiveness, many companies started to integrate DT in the design of their products and services, committing themselves to becoming design leaders (Dunne & Martin, 2006). Organizations those look for broadening their services within the field of industrial design, integrate DT for addressing complex challenges (Chen et al., 2018; Dorst, 2011). More than its transformation from product to process and services the DT has become a key element in company strategy (Bucolo & Matthews, 2010; Camillus, 2008; Carlopio, 2009; Fleetwood, 2005; Verganti, 2006). Companies stood in a better economic market place with the integration of DT, researches indicated (Moultrie & Livesey, 2009; Nussbaum, 2006; Verganti, 2008). DT transforms by integrating innovation, the current business strategy to the creation of new visions, and alternative scenarios, differing in thetechnique and tools (Bucolo & Matthews, 2010; Cooper et al., 2010; Martin, 2007). Design has contributed to successful business performance at strategic as well as operational levels (Matthews et al., 2017). In today's economy, employers want people who can learn over time and solve complex problems (Belkin, 2015).

A case study examining DT methodologies in action in 22 organizations including large corporations, start-ups, government agencies and NGOs observed the impact on innovation processes. It concluded that, DT has the potential for significantly improving innovation outcomes both creative and analytic co-ordinated at an end-to-end system (Liedtka, 2017; Liedtka et al., 2017). The combined relationship of understanding of the purpose and mode of operation of the systems and DT play a vital role for the designers to improve the quality of human experience (Buchanan, 2019).

Innovation Solutions is the Need of the Hour

Responding to the need for innovation, the global market looks at students and graduates to offer innovative solutions to pressing issues

in all sectors which ultimately calls for innovative approaches such as 'DT' to offer test new policy solutions (Lewis et al., 2017) for public problems (Iskander, 2018; Kimbell-Lopez et al., 2016; Lewis et al., 2020) and in alignment with the policy processes. The gap between designers and citizens is narrowed where DT constitutes a 'bottom-up' approach (Kolko, 2018). The national education policy 2020 announced by Indian Ministry of Education emphasizes on holistic multidisciplinary education aimed in redirecting an unemployed youth to find employment through a self-sustained skill-based model with an objective to device and implement robust solutions to its own problems that are in harmony with different programs and initiatives of Government of India to build a self-reliant society. The new education policy would not only focus in preparing students to perform well on exams, but also to equip them with powerful skill sets that will help them succeed in their career

Observations in Implementing Design Thinking Strategies Within Engineering Students

Observations carried out among a heterogeneous sample of engineering students at SNS College of Engineering, Coimbatore, Tamilnadu, India, to measure and compare the skills associated to verbal, quantitative aptitude and logical reasoning (VQALR) and the problem solving ability between third year (n=430) and final year (n=380) collegiate engineering students. The third year students were exposed to DT approach for three academic years from June to April (2018-19, 2019-20, and 2020-21) and the final year students were exposed to the approach for a year between June 2020 to April 2021. Observations showed the perceived DT ability among the third year students who were exposed to DT approach for three years were much better; they performed well in VQALR and problem solving ability compared to final years those were less exposed to the approach. The results were obviously reinforced in the student's performance when they came to their final year during campus recruitment drives which started from June 2021 onwards, where companies had conducted Aptitude reasoning and logical reasoning tests as part of their recruitment process. The student performed well in these tests. The results of the study provided a deeper insight on the effectiveness of DT pedagogy in engineering education.

CONCLUSIONS

This paper has outlined the human-centered DT process, the concept description, process operation, and experimental results, as expressed across the literature reinforcing and recommending the DT practices for adoption in schools, colleges, and organizations, in addition to a variety of new fields. DT can largely be seen as an untapped source of insight, with greater impact on the field, and a potent tool when in practice. The following suggestions for adopting DT in the instructional pedagogy have been drawn from the literature reviewed in this study:

1. Adopting the strategies of DT and integrating them in collegiate education would be a better tool to offer feasible solutions for industrial problems, solve societal challenges besides improving the skill development and behavioral pattern of students thus providing a deeper insight for practitioners to assess on the concepts.
2. To have cognitive reflections along with DT as impactful elements so as to explore more depth, power, and effectiveness of concretizing the concept. Further, develop easy ways for all instructional design professionals to use and communicate core practices and key competencies in the field.
3. To thoroughly reach into the literature and study other methods of instructional design fields so as to build a clarity and thorough reflection for a feasible solution. Being a human cantered approach, awareness on who is doing the thinking in the design process will be beneficial for practitioners to study the impact upon the intended outcomes and design decisions.
4. The methodology, challenges, assumptions, and models developed by the practitioners for the instructional design field, the common key elements identified, mapping done for core competencies and tools for solving a specific problem by DT, could be documented for future reference. This would help designers to understand whenever new challenges are posed; they could explore the literature first to determine whether DT methodology has been effectively used to address similar challenges.

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