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Design Thinking Learning Model on Digital Workspace for Sustainable Products and Services to Enhance Digital Entrepreneurs (DTLDW-SPSEDE Model)

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Abstract

This study aims to: (1) a design for design thinking learning model on digital workspace for sustainable products and services to enhance digital entrepreneurs; and (2) evaluate the design thinking learning model on digital workspace for sustainable products and services to enhance digital entrepreneurs. The sample is made up of ten specialists who were chosen using purposive sampling. The instrument used in the study was an evaluation form of the leaning model. The arithmetic mean and standard deviation were employed in the investigation. The results show that: (1) the design thinking learning model on digital workspace for sustainable products and services to enhance digital entrepreneurs consists of four key components: 1) Design thinking process, 2) Digital Workspace, 3) Design thinking tools and 4) Sustainability metrics. (2) All ten specialists agreed that the design thinking learning model on digital workspace for sustainable products and services to enhance digital entrepreneurs designed through this study shows the highest level of appropriateness.

Keywords: Design thinking, Digital workspace, Sustainable development, DTLDW-SPSEDE model

1. Introduction

The COVID-19 epidemic, which began in March 2020, presented instructors and students with unprecedented hurdles in the traditional classroom style. Educators worldwide were forced to adjust to remote education as institutions followed social distancing norms and curtailed face-to-face connection. This quick transition left instructors with little time to adjust current lesson plans, study best practices in distant education, or build expertise with now-required educational technology. Studies conducted after the outbreak of the COVID-19

pandemic have revealed that instructors believe they are unprepared to teach in remote locations (Gicheva, 2021). As institutions were compelled to eliminate in-person contact and change to online learning overnight, firms forced to relocate to a home office were slower to adjust their learning methods. However, discussions with our specialists revealed that the "digital experiment" during the lockdown would most likely provide long-term insights and demonstrate digital organizational learning from a different perspective (Susilawati & Handoyo, 2022). With the increase in remote work, digital learning technologies designed to stimulate learning are gaining interest. Since digital workspace can be designed to facilitate the learning process and digital technologies allow interactive design thinking and risk-free simulations, digital working spaces could potentiate the design thinking process in both formal and informal learning.

Design thinking is a human-centered approach that uses design tools and mindsets to develop creative and inventive solutions to diverse social and economic problems (Chung, 2014). Students focus on not well-defined and unstructured problems that do not yet have solutions (Groeger & Schweitzer, 2020). The educational value of design challenges is created by introducing 21st-century skills and traits to pupils (Loke & Matthews, 2020). The design thinking process is based on the principles of empathizing to understand user needs, defining the needs, conducting trials, prototyping, receiving user feedback, redesigning the process (Lock & Scott, 2021), and expressing yourself creatively in addition to using words and symbols (Chambers, 2020). There is no single approach to follow the design thinking process because there is no consistent explanation of design thinking in literature. Stanford University's Hasso Plattner Design School, IDEO, and Design Council have produced many designs process models. Collecting information to comprehend the problem, applying creative thinking abilities in the process, and being experienced throughout the process were all emphasized in all models (Meyer, 2007). A solid set of techniques has been established due to the continuous co-evolution and vetting of design thinking. However, it has also created confusion given the number of tools, techniques, books, seminars, and, more recently, online training resources accessible. Understanding design thinking methodologies by first learning about organizational frameworks might be helpful. Even in this situation, there are several frameworks to pick, each with unique attributes and preferences. To the inexperienced, this might be not very safe, too. Despite this, enough time is given to look at these issues; it quickly becomes evident that throughout various frameworks, there is significant uniformity. These might be seen as prototypes, in a sense: each is built on ideas and lessons learned from earlier iterations. Design thinking is an inextricable part of teaching practices for people. Design approaches with repetitive processes aimed at problem-solving can guide people towards their sustainable learning, which is critical for product and service development and organization development (Hagger et al., 2008).

Today's workplace should provide employees with a consistent, consumer-like user experience that is entirely in sync with how people function today (Ferreira, 2021). The digital workplace solutions (DWS) that corporate leaders want to use will increase employee engagement, enabling employees to achieve business outcomes more rapidly, and empower individuals to save expenses and increase efficiency (Attaran et al., 2019). It is the desire of

these executives to have a complete IT solution that is compatible with the way people function today, regardless of platform or location. As a consequence, workers are increasingly seeking a digitally connected work experience that is customized, real-time, mobile-enabled, collaborative, and blends consumer-oriented trends and technology into their daily work lives (Shivakumar, 2019).

In this research, we propose a learning model for design thinking intended to develop a design thinking learning model on a digital workspace for sustainable products and services to enhance digital entrepreneurs, with the learning model's goals being sustainable products and services developed. That could help other educational institutions, companies, or organizations implement similar projects.

2. Literature Review

2.1 The Origins of Design Thinking

Design thinking draws on a wide range of disciplines and methodologies, including software development, engineering, anthropology, psychology, the arts, and business, to develop innovative approaches to solving design problems. At the moment, design thinking can be found in a variety of different disciplines and businesses. Over several decades, a quasi-Darwinian process of natural selection has been used to select the best and most generalizable procedures and practices. Design is being pioneered by pioneering design firms such as IDEO and frog, and it is being supported by academic institutions such as Stanford's d.school and the Rotman School of Management. By the time the term "design thinking" begins to gain popularity, design has already become standard practice in the industry and across the media.

2.1.1 d.school Framework

The university's history of using this teaching approach has resulted in one of the most commonly used design thinking frameworks at Stanford University, which can be found in one of their courses on design thinking. Identify, define, brainstorm, design, prototype, and test are the critical steps in the Stanford d.school framework, according to the school. The visual representations of these concepts are depicted in Figure 1.

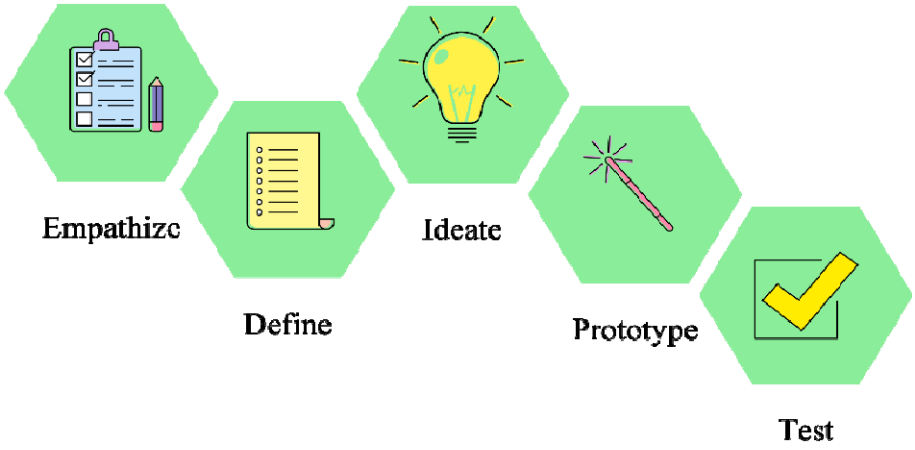


Figure 1. Stanford d.school design thinking framework (Plattner et al., 2015)

During the empathize phase, methods such as interviews, shadowing, seeking to understand, and nonjudgmental approaches are prioritized over judgmental approaches. Understanding personas, role objectives, decisions, challenges, and pain points become the primary focus of the define phase during which time the emphasis shifts. During the ideate phase, participants exchange ideas. Any and all ideas may be considered worthy, a diverge and converge method may be employed, ideas may be extended using a "Yes and" method, and prioritization may be required on a regular basis during the prototype phase, it is possible to create mockups and storyboards, to take a "keep it simple" approach, and to use methods such as failing fast and iterating rapidly. The testing phase may include techniques such as identifying and understanding impediments, identifying and understanding what works, evaluating tests through role-plays, and performing tests in rapid iterations (Camacho, 2016).

2.1.2 IDEO Framework

IDEO's Design Thinking methodology is another well-known framework. This framework's key phrases are discovery, interpretation, ideation, experimentation, and evolution. Figure 2 shows an example of each of these.

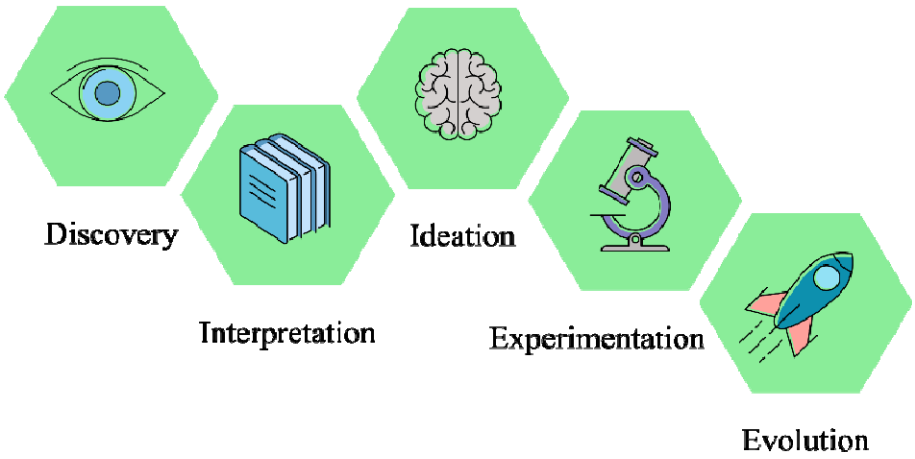


Figure 2. IDEO design thinking framework (Riverdale Country School and IDEO, 2011)

Discovery is concerned with understanding the approach to a challenge by defining it, conducting research, and gathering inspiration. It is the first phase of the process. It is during the interpretation phase that narratives are told, meaning is sought, and opportunities are conceptualized and defined. Ideation is the process of conceiving, developing, and refining novel concepts. The experimentation phase includes the creation of prototypes and the solicitation of feedback. Tracking one's own learning and progress is an important part of evolution (Moon, 2020).

2.1.3 Double Diamond Design Methodology

The design methodology developed by the UK Design Council, known as the Double Diamond, is at the heart of the original framework on which most other innovative design frameworks are based. Design process is described in a straightforward, comprehensive and visually appealing manner. The Double Diamond has become well-known throughout the world, with millions of references to it being found on the Internet. The Double Diamond, created by the Design Council, communicates the design process to both designers and non-designers alike. The Double Diamond is depicted in Figure 3 as an illustration.

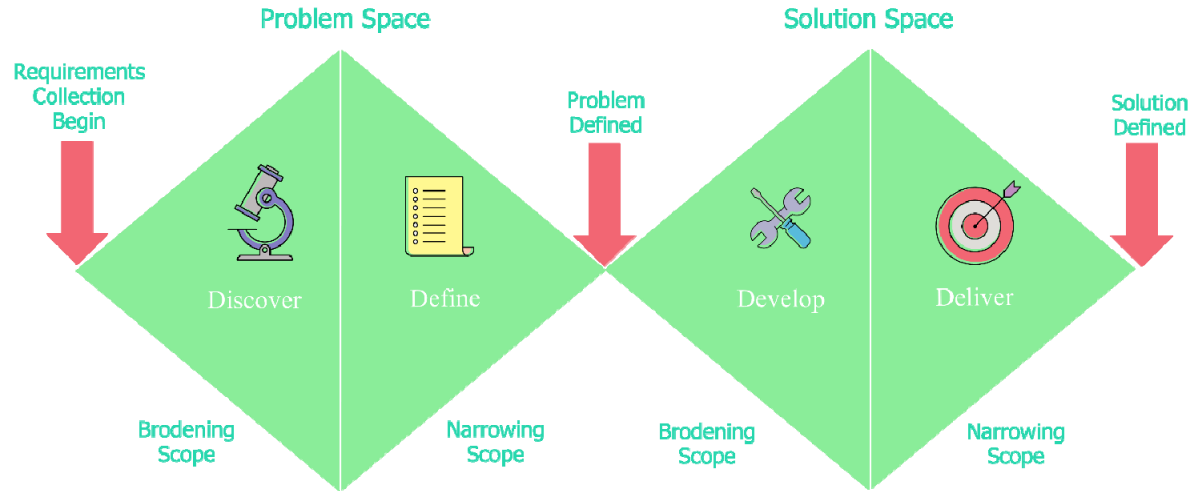


Figure 3. Double diamond design thinking methodology (Zekioglu et al., 2007)

The two diamonds in this approach represent the problem space and the solution space, respectively. In each diamond, the left-hand side represents the process of gaining a more comprehensive or in-depth understanding of a particular issue (divergent thinking). The right side of each diamond, on the other hand, represents the act of concentrating one's efforts (convergent thinking). Finding, defining, developing, and delivering the Double Diamond's key phrases are all part of the process. Problem space activities include discovering and defining issues, whereas solution space activities include developing and delivering solutions. Throughout this methodology, the phases are predetermined. However, depending on what we learn, the objectives or intent of each of these phases may differ (Clune & Lockrey, 2014).

2.2 Design Thinking for Sustainability

Beginning in the 1950s, Design Thinking became popular as a problem-solving technique among those working in the fields of industrial design, science, and technological innovation. In the 1960s, open and collaborative problem-solving began to take the place of a closed-off and selective approach to problem-solving. A growing number of companies are incorporating customer feedback into their design processes. The field of human-computer interaction (HCI) was established in the 1970s, as computer and technology usage increased.

2.2.1 Sustainable/Efficient Design

In 1992, McDonough and Braungart published the Hannover Principles, which emphasized the rights of humanity and nature to coexist, accepting responsibility for the consequences of design, creating safe objects of long-term value, and eliminating the concept of waste from the design process. The concept of eco-efficiency is a fundamental tenet of sustainable design. "Providing competitively priced goods and services that meet human needs and improve quality of life while gradually reducing ecological impacts and resource intensity throughout the life cycle to a level at least equal to the Earth's estimated carrying capacity," according to the World Business Council for Sustainable Development (WBCSD) (Bandeira, 2020).

Briefly stated, it is about generating more value while having less impact on the world around us.

2.2.2 Replacement of a Product or Service

As an innovation strategy, a product-service system (PSS), or the coordination of a set of products and services into a unified offering, broadens and deepens the scope of sustainable designs and development (Fernandes, 2022). The social, economic, and environmental consequences of a PSS approach become inextricably linked to the shift from viewing production and consumption as two distinct entities to viewing the entire product life cycle as a single closed-loop system (Mont, 2002). The PSS approach, in addition, places a greater emphasis on the use phase of the P/SLC rather than the product design phase in research and development. Consumer sharing, renting, and leasing schemes, as well as producer take-back programs for refurbishment, are examples of alternative product use scenarios that can be created by a product sharing system.

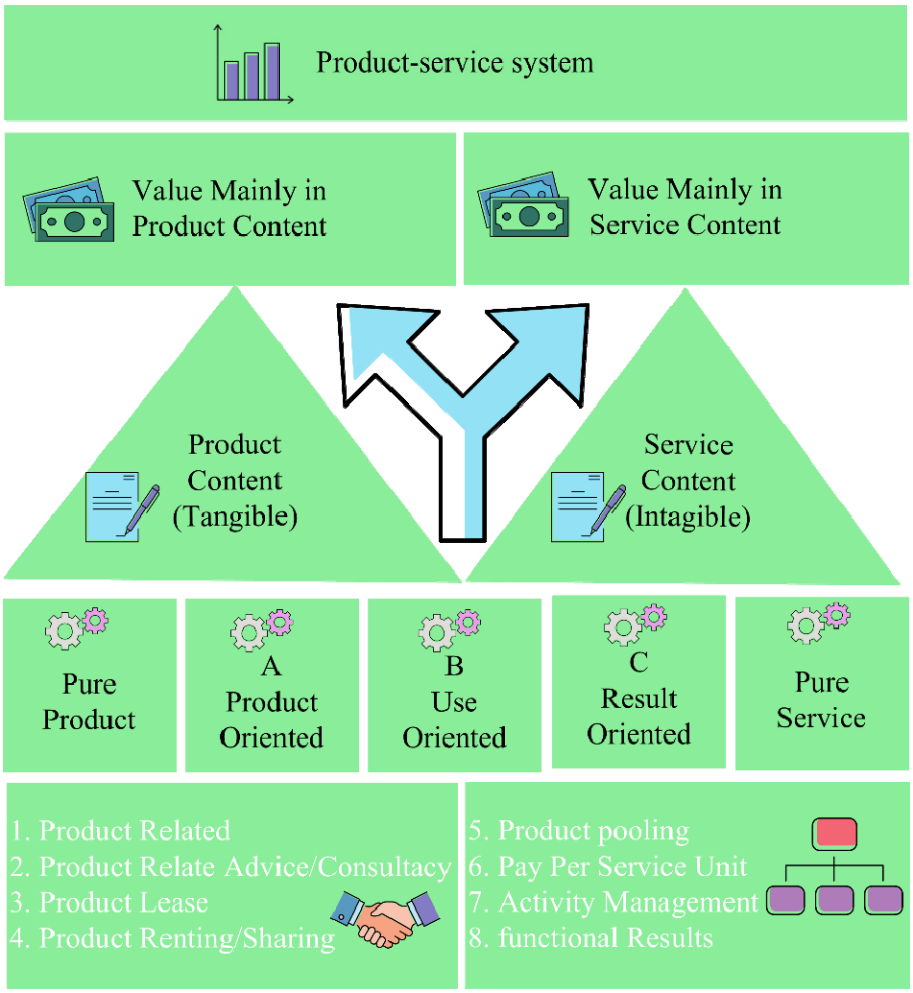


Figure 4. Product-service system categories (Tukker, 2004)

A PSS can be implemented in one of three ways, as illustrated in Figure 4. Each approach has different implications for long-term sustainability, as illustrated in the following paragraphs. In a product-oriented PSS (PO-PSS), in which the product is owned by the consumer, the firm can provide additional services to ensure the product's long-term durability, among other things. Because the service provider owns the product in a user-oriented PSS (UO-PSS), it is more likely that the product will be refurbished and repurposed in the future. Through a service contract, the service provider sells only the "function" to the customer, and the customer pays the service provider for the "function." When a customer purchases results from a results-oriented PSS, he or she is unconcerned about the methods by which the firm achieves those outcomes on their behalf. Photocopiers could be used during off-peak hours, and ad hoc copy services could be provided as needed as a result of this arrangement.

2.3 Digital Workplace

Charles Grantham and Larry Nichols coined the phrase "Digital Workplace" in 1993, and it has since become widely used (Grantham & Nichols, 1993). It is defined as "the collection of all digital technologies that employees use to carry out their duties in a company" when it comes to the digital workplace. An intranet, communication tools such as email and customer relationship management (CRM), an enterprise resource planning system, a human resource management system, a calendar, and other enterprise processes or tools that assist in the basic day-to-day operations of a company are examples of such tools (Sivunen & Laitinen, 2019). For a company to achieve long-term success in today's digital-first, consumer-centric business environment, a successful digital workplace transformation is critical (O'Donnell, 2021). Every aspect of the workplace is affected by the digital workplace, including physical workspaces, technology, and even people's behaviors (Hıdıroğlu & Oğlu, 2022). Because of the above-mentioned ramifications, the effects of changes in one area may have consequences in other areas as well. Figure 5 demonstrates how to accomplish this.

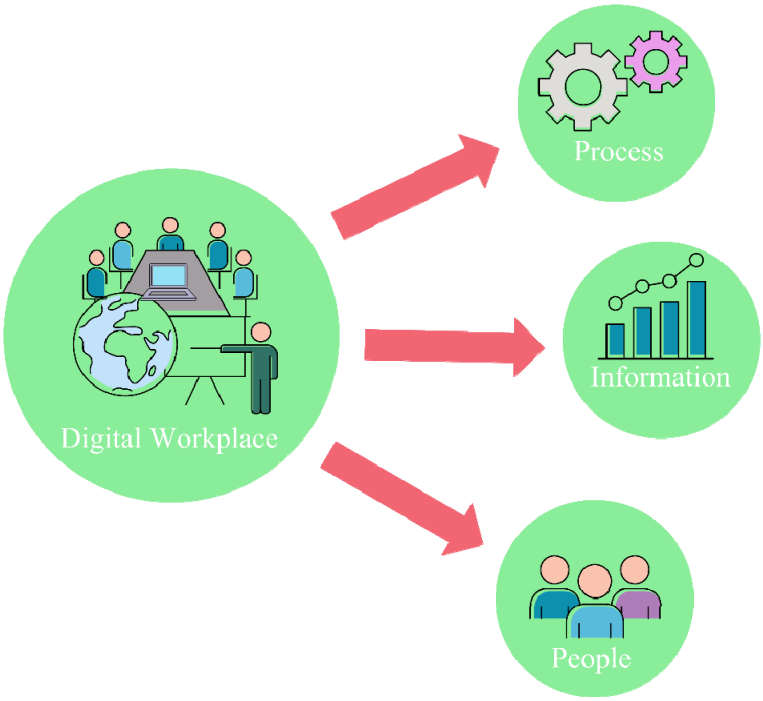


Figure 5. Digital workplace and creating connections

According to Intel, the three pillars of a digital workplace are technology, an agile workplace, and collaborative processes and tools (Ifenthaler, 2018). Individual and team performance, as well as organizational performance, are the three building blocks of a framework for the digital workplace, according to the findings of an additional study conducted by Info centric Research (Ghosal & Sarkar, 2020). Individuals, teams, and organizations cannot function properly unless they have all of the information and functions that are contained within these building blocks. They serve as a central repository for both personal and team or project tasks, allowing for real-time monitoring of all projects and activities that need to be completed in a timely manner.

3. Methods

3.1 Research Scope

The sample consisted of ten experts, all of whom worked as lecturers in business management, thinking skills development, product design, and educational technology, and all of whom had at least five years of experience in their respective fields. They were chosen through the use of purposive sampling. All of these research tools were used: a Likert scale, an arithmetic mean, and a standard deviation.

This research was conducted in two phases as follows:

Phase 1: The DTLDW-SPSEDE model is a design thinking learning model on a digital workspace for sustainable products and services. The instruments of study for this phase were 1) the DTLDW-SPSEDE model and 2) evaluating the DTLDW-SPSEDE model.

Phase 2: The sample evaluated by the DTLDW-SPSEDE model was made up of ten experts, all of whom worked as lecturers in management, thinking skills development, product design, and educational technology and had at least five years of experience. Purposive sampling was used to select them. The following criteria were used: Likert scale, arithmetic mean, and standard deviation 4.51-5.00 at highest of appropriate suitability 3.51-4.50 at the height of appropriate suitability 2.51-3.50 at moderately appropriate suitability 1.51-2.50 at a low of appropriate suitability 0.00-1.50 at lowest of appropriate suitability.

4. Results

This section contains the study's findings. The goal of this part is the development of the Design Thinking Learning Model on Digital Workspace for Sustainable Products and Services to Enhance Digital Entrepreneurs (DTLDW-SPSEDE model). Figure 6: The DTLDW-SPSEDE model is shown below.

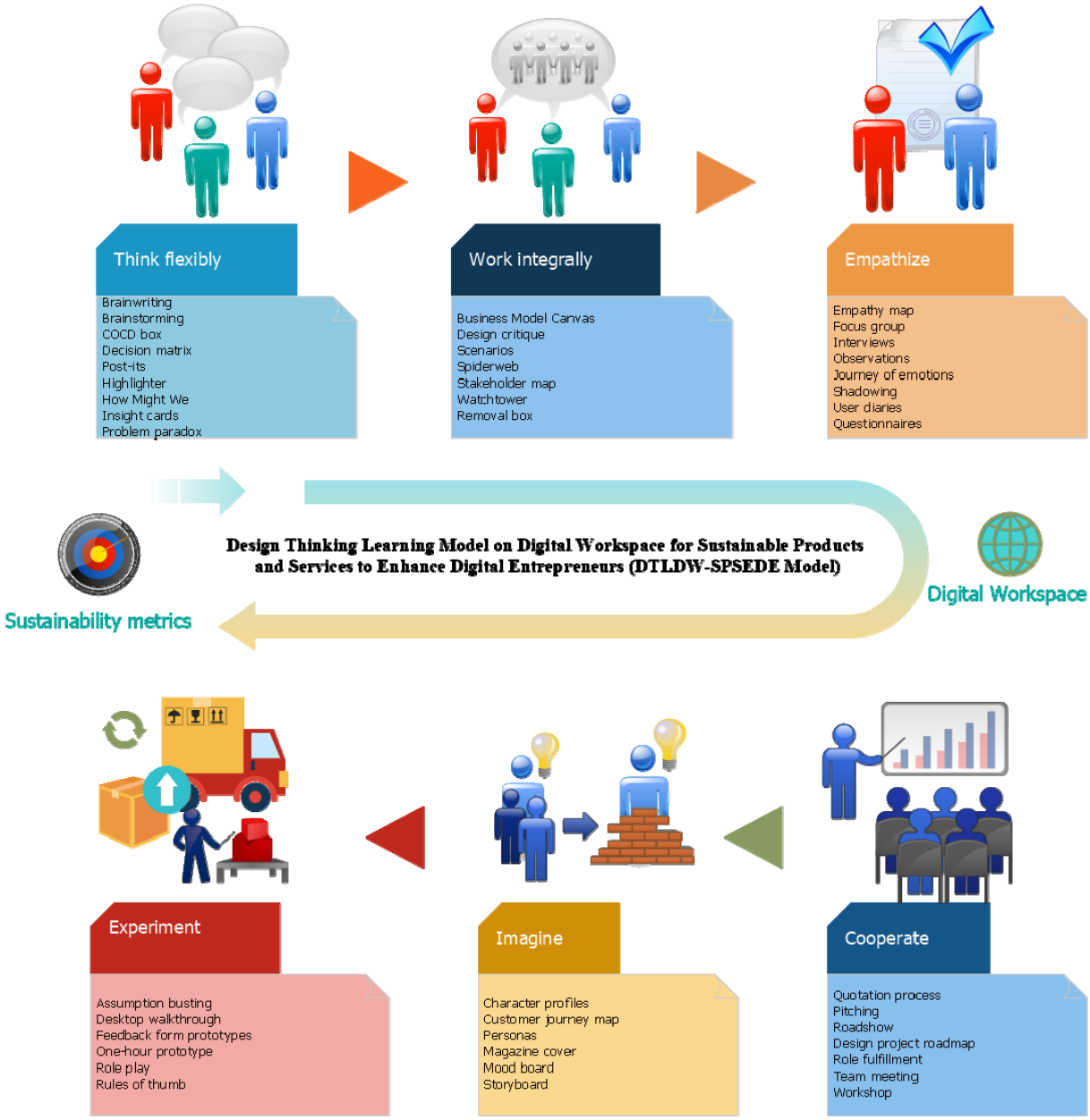


Figure 6. The design thinking learning model on digital workspace for sustainable products and services to enhance digital entrepreneurs (DTLDW-SPSEDE Model)

4.1 Design Thinking Process

When it comes to design thinking, a change in perspective is required. To see the possibilities in the seemingly impossible, to make connections that were previously unnoticed, and to work in interdisciplinary teams that challenge everyone to find solutions to a problem that has been presented. When it comes to developing new products and services, design thinking places the user first. Design thinking, we believe, is all about channeling imagination and unrelenting experimentation in order to produce true innovation.

4.1.1 Think Flexibly

As design thinkers, we will constantly seek to see things from a different perspective by addressing a wide range of issues. To start with the big picture and then zoom in on the details, analyze, and schematize what you've found. This necessitates the development of cerebral flexibility. Flexible thinkers come up with exciting new ideas and solutions that are unavailable to those who do not possess this trait. They maintain a positive and pleasant demeanor while remaining cognizant of the importance of critical thinking.

4.1.2 Work Integrally

A problem is rarely self-contained, and it is not always easy to define and articulate precisely what is wrong. In the same way, a solution cannot be viewed in isolation from a single point of view or from a single perspective. Problems and their solutions are typically far too complicated for this approach. To achieve coherence, integral work necessitates collaboration and connection with others. experts must connect their skills and activities in order to arrive at the most appropriate answers The complexity of issues and their solutions necessitates the development of novel problem-solving methodologies that place the issue and its solutions within their larger context of occurrence, rather than within their smaller context of occurrence. The ability to do so exists if one actively seeks connections between challenges that are similar both within and outside of the organization. Challenges are not only difficult, but they are also constantly changing. Searching for answers that are both practical and dynamic is made easier with the help of design thinking. In order to effectively implement solutions, all elements and cross-linkages must be addressed throughout the design process, particularly during the phases of defining the problem and brainstorming possible solutions.

4.1.3 Empathize

Throughout the design process, the design thinker empathizes with potential end-users in order to better understand their needs and wants, as well as their expectations. This can be accomplished through the use of interviews, observation, and surveys, among other methods. In order to gain insight beyond broad assumptions and develop solutions that meet the needs of the consumers in question, the design thinker must demonstrate a genuine and structural interest in the consumers in question.

4.1.4 Cooperate

Design thinking necessitates the participation of multiple people. This implies that a design team is formed at the start of every design process, with team members working together to develop innovative solutions to (complex) problems. There is no longer any relevance to the image of the lone designer who comes up with beautiful ideas on his or her own.

4.1.5 Imagine

Make sure you have drawings, videos, a performance, animations, prototypes, and other visuals to demonstrate how an idea will evolve as it is refined. Make it possible for individuals to participate in experiencing the solutions rather than simply hearing about them. It is this fundamental mindset that assists design thinkers in improving their thinking about

ideas and solutions, rather than simply presenting something to another person. In order to accomplish this, research findings may be visualized in an infographic, or early thoughts that spark the creative imagination may be jotted down.

4.1.6 Experiment

Experimenting is a method of learning by doing that is used to improve one's skills. It begins at the beginning of a design process and ends when the solution to the design challenge has been successfully implemented in the real world. This critical frame of mind is centered on making mistakes, falling, getting back up, and giving 'crazy' ideas a chance to succeed. This idea may be at odds with an organizational culture that places a high value on linearity, certainty, and the avoidance of mistakes.

4.2 Digital Workspace

When it comes to app, data, and desktop delivery, a digital workspace is a technological framework that allows for the distribution and management of these items. It enables employees to access their applications and data in real time from any device and from any location, regardless of whether the data is stored in the cloud or in a data center, according to their needs. IT and end-users must have a consistent, contextual, and secure experience when using a digital workplace solution in order for it to be effective. The digital workspace includes:

4.2.1 App and Desktop Virtualization

From a single interface, users can access everything they require for their jobs, regardless of whether they are on-premises or in the cloud. Because of this, people can be productive using any device of their choosing.

4.2.2 File Sharing and Content Collaboration

The ability for individuals and teams to collaborate on material across multiple devices and clouds enables them to publish, share, sync, save, and manage it while maintaining a consistent experience within the workplace.

4.2.3 Unified Endpoint Management for All Mobile Devices

Information technology teams have centralized control over every device that is used to access the workplace, allowing end users to operate safely on the devices of their choosing.

4.2.4 Secure Access to SaaS Apps/Secure Surfing

Workspaces are aware of the way in which users interact with programs and data. Analyzing these patterns of use assists in the proactive identification of internal and external risks prior to the occurrence of a costly breach of confidentiality.

4.2.5 Single Sign-On (SSO)

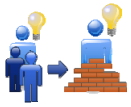
Professionals only need to log in once to gain access to everything they require, while information technology is in charge of context-sensitive access. This provides users with a

superior experience while also ensuring the security of the company's information.

4.3 Design Thinking Tools

The majority of the tools can be applied throughout the design process, and in most cases, they interact with more than one fundamental attitude, which is one of the factors that makes them so appealing for use in a design project in the first place. Figure 1 depicts an illustration of a design thinking application and tool in action.

Table 1. Design thinking applications and tools

Fundamental attitude	***Applications***	***Tools***	
Think Flexibly 	Balance between: - diverging and converging - analysis and synthesis - zooming in and zooming out - optimism and a critical view	Brainwriting Brainstorming COCD box Decision matrix	Post-its Highlighter How Might We Insight cards Problem paradox
Work integrally 	Become a T-shaped person Look for the innovation sweet spot	Business Model Canvas Design critique Scenarios Spiderweb	Stakeholder map Watchtower Removal box
Empathize 	Develop empathic ability	Empathy map Focus group Interviews Observations	Journey of emotions Shadowing User diaries Questionnaires
Cooperate 	Cooperate in interdisciplinary teams	Quotation process Pitching Roadshow Design project roadmap	Role fulfillment Team meeting Workshop
Imagine 	Learn to visualize Storytelling Creating prototypes for visualization	Character profiles Customer journey map Personas	Magazine cover Mood board Storyboard
Experiment 	Learn to experiment Develop an eye for serendipity	Assumption busting Desktop walkthrough Feedback form prototypes	One-hour prototype Roleplay Rules of thumb

4.4 Sustainability Metrics

Sustainability objectives are being woven into current key performance indicators (KPIs), which define what should be monitored and metrics, which define how KPIs will be monitored, to ensure that they are met. A list of environmental parameters that may be used to develop product or process design goals:

4.4.1 Energy Usage Metrics

Energy use measures include the total amount of energy spent throughout the product-service life cycle (P/SLC), the amount of renewable energy used, and the amount of electricity required during operation.

4.4.2 Water Consumption Metrics

The total amount of freshwater drunk during P/SLC.

4.4.3 Material Burden Metrics

Material burden measures include the use of toxic or hazardous chemicals in manufacturing, the total amount of industrial waste generated during production, and the amount of greenhouse gases emitted during the P/SLC.

4.4.4 Material Recovery and Reuse

Recyclable material recovery time, the purity of recyclable materials recovered, and the percentage of recycled materials used as an input into the product are all important considerations.

4.4.5 Source Volume Metrics

Product mass, usable working life, and the proportion of packaging that is recycled are all metrics that can be used to calculate source volume.

4.4.6 Economic Metrics

Economic indicators include the average life-cycle expenses incurred by the manufacturer, the customer's purchase and operating expenses, and the customer's cost of revalorization, among others.

4.4.7 Value Creation Metrics

Increasing the use of renewable resources, reducing pollution, improving human health and safety, raising the overall standard of living in the community, and improving customer environmental performance are all goals of the company.

4.5 The Evaluation of a DTLDW-SPSEDE Model

From Table 2, when examined, it appears that four items in the evaluation results received the highest level. When examining the results, the highest scores were for the sustainability metrics aspect ($\bar{x}$ = 4.80, S.D. = 0.42). The design thinking process scores were the lowest ($\bar{x}$ = 4.60, S.D. = 0.52). Design thinking tools and digital workspace were ranked as the highest

levels ($\bar{x}$ = 4.70, S.D. = 0.48). Overall, they were ranked at the highest level ($\bar{x}$ = 4.70, S.D. = 0.48).

Table 2. Experts' evaluation of the DTLDW-SPSEDE model

Evaluation Lists	***Level of suitability***	***Level of assessment***	
		$\bar{x}$	***S.D.***
1. Design thinking process	Highest	4.60	0.52
2. Design thinking tools	Highest	4.70	0.48
3. Digital workspace	Highest	4.70	0.48
4. The sustainability metrics	Highest	4.80	0.42
Overall	**Highest**	**4.70**	**0.48**

5. Conclusion

The DTLDW-SPSEDE model can be broken down into four distinct components. The first element is concerned with the design thinking process, which includes the following steps: 1) Think flexibly, 2) Work integrally, 3) Empathize, 4) Cooperate, 5) Imagine, and 6) Experiment. The design thinking tools are the second component of the design thinking process. The third element is the digital workspace, which includes features such as 1) app and desktop virtualization, 2) file sharing and content collaboration, 3) unified endpoint management for all mobile devices, 4) secure access to SaaS applications/secure surfing, and 5) single sign-on (or single sign-on). Furthermore, the final element is concerned with the sustainability metrics. According to the assessment of ten experts, the DTLDW-SPSEDE model has the highest level of appropriateness ($\bar{x}$ = 4.70, S.D. = 0.48). Within the DTLDW-SPSEDE model, these building blocks do not exist in isolation from one another. They blend into each other depending on their tasks and situations. They serve as a learning model for developing strategies and concepts for products and services to enhance digital entrepreneurs.

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