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Department of Mechanical Engineering
Design Thinking and Innovation

Unit-II

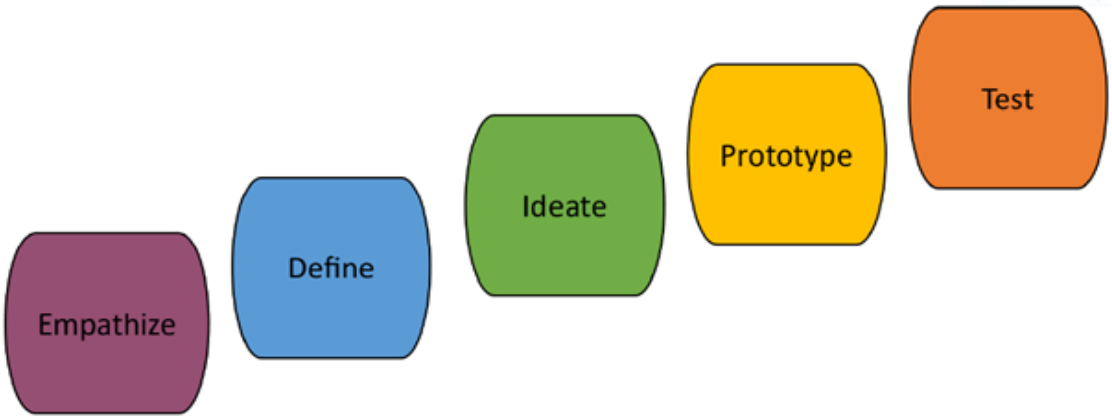
UNIT - II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - persona, costumer, journey map, brainstorming, product development

2.1. Design thinking process (empathize, analyze, idea & prototype)

→ The Design Thinking process involves five core stages: Empathize, Analyze, Ideate, Prototype, and Test

Stanford d. school 5stage process model



Stage 1: Empathize

- In this phase, the focus is on understanding the users or stakeholders involved in the problem
- It requires deep engagement, observation, and gathering insights to capture what people truly need.
- **Goal:**
  - Understand the user's needs, pain points, and desires.
- **Activities:**
  - **User interviews:** Conduct one-on-one interviews to gain insights into user experiences.
  - **Observation:** Observe users in their natural environments to identify behaviours and challenges.
  - **Shadowing:** Spend time with users to better understand their daily routines and decision-making processes

- **Example:**
  Imagine you're designing a better public transport system. The "empathize" stage would involve spending time with commuters, bus drivers, and other stakeholders, identifying their pain points, such as long waiting times or discomfort during rides.

Stage 2: Analyze/Define

- The analyze or Define stage involves synthesizing all the information collected during the empathize stage
- The goal is to define the problem clearly, usually in the form of a problem statement
- **Goal:** Clearly articulate the problem statement and identify user needs
- **Activities:**
  - **User personas:** Create detailed profiles of representative users to guide design decisions.
  - **Journey maps:** Visualize the user's experience from start to finish to identify pain points and opportunities.
  - **How might we question:** Generate open-ended questions to inspire creative problem-solving.
- Process the information gathered to define the problem clear

→ The **Analyze/Define** stage in the **Design Thinking Process** involves **synthesizing research findings** gathered from the **Empathize** phase. It aims to identify the **core problem**, ensuring that solutions address the right challenges.

This phase includes:

- Organizing insights from **personas, empathy maps, and customer journey maps**.
- Identifying **pain points** and defining the **problem statement**.
- Using the **"How Might We" (HMW) framework** to reframe challenges into opportunities.

Importance of the Analyze/Define Stage

- ✓ **Ensures problem clarity** – Focuses on the root cause rather than symptoms.
  ✓ **Guides ideation** – Provides a well-structured problem statement for brainstorming.
  ✓**User-centered approach** – Aligns solutions with real user needs.
  ✓ **Prevents misdirection** – Avoids wasting time on irrelevant issues.
  ✓ **Encourages innovation** – Helps generate meaningful and impactful solutions.

Uses of the Analyze/Define Stage

- 🔷 Used in **product development** to ensure features align with customer needs.
- 🔷 Applied in **service design** to enhance user experience.
- 🔷 Helps in **social innovation** by addressing societal problems effectively.
- 🔷 Essential in **business strategy** to develop customer-focused services.
- 🔷 Applied in **education** to improve learning experiences based on student challenges.

Using the "How Might We" (HMW) Framework for Problem Definition

The **HMW framework** transforms **pain points** into **opportunity-driven** problem statements. It encourages **open-ended** and **innovative thinking**.

Structure of an HMW Question:

👉 **"How Might We [action] for [user] in order to [desired outcome]?"**

- **Example:**
  In the public transport case, after gathering data, you might find that the biggest issue commuters face is unpredictability in bus arrival times.

Stage 3: Ideate

- In this stage, the goal is to generate as many ideas as possible, pushing creativity and innovation boundaries without constraints.
- Brainstorming sessions are typical here, aiming to develop various potential solutions.
- **Goal:** Generate a diverse range of potential solutions.
- **Activities:**
  - **Brainstorming:** Encourage students to generate as many ideas as possible without judgment.
  - **Mind mapping:** Visually organize ideas to identify connections and patterns.
  - **Sketching:** Create quick sketches to visualize potential solutions.
- Brainstorming and generating creative solutions to address the defined problems.

→ The **Ideate** phase is the third stage in the **Design Thinking Process**, where teams generate **creative solutions** to the problem identified in the **Define** stage. This phase focuses on **brainstorming, free thinking, and exploring possibilities** without limitations.

It involves:

- Generating multiple ideas for solving the problem.
- Encouraging **divergent thinking** (exploring many possibilities).
- Selecting and refining the best ideas for prototyping.

Importance of the Ideate Stage

✓ **Encourages innovation** – Unlocks new perspectives and unconventional solutions.
✓ **Diverse problem-solving** – Generates a variety of ideas from different viewpoints.
✓ **User-centered solutions** – Keeps the focus on solving user pain points.

✓ **Bridges the gap between problem and solution** – Moves from defining the issue to creating potential fixes.
✓ **Avoids premature judgment** – Prioritizes **quantity over quality** to explore all possible directions.

Uses of the Ideate Stage

- 🔷 Used in **product design** to create innovative features.
- 🔷 Applied in **business strategy** to improve services and processes.
- 🔷 Helps in **education** to develop interactive and engaging learning methods.
- 🔷 Essential in **healthcare** for designing patient-friendly treatments.
- 🔷 Supports **social innovation** by tackling societal problems with fresh approaches.

➢ **Example:**
For public transport, ideation could lead to ideas like real-time bus tracking apps, priority lanes for buses, or dynamic scheduling based on traffic data

Stage 4: Prototype

➢ Prototyping turns ideas into tangible products, creating a minimum viable version of the solution to explore how well it solves the problem.
➢ **Goal:** Create tangible representations of potential solutions
➢ **Activities:**
  - **Rapid prototyping:** Build low-fidelity prototypes to test ideas quickly and iteratively.
  - **User testing:** Gather feedback from users to refine prototypes and identify areas for improvement.

→ The **Prototype phase** is the fourth stage in the **Design Thinking Process**, where ideas generated during the **Ideate phase** are transformed into **tangible representations** or models. These prototypes are used to **test, refine, and improve solutions** before full-scale implementation.

It involves:

- **Building low-fidelity or high-fidelity models** of the solution.
- **Testing the functionality and user experience** in a controlled setting.
- **Identifying gaps and iterating** based on user feedback.

. Importance of the Prototype Stage

✓ **Reduces risk** – Helps in identifying potential failures before full implementation.
✓ **Enhances user experience** – Allows real users to test the solution and provide feedback.
✓ **Encourages quick learning** – Iterative process helps refine the design continuously.
✓ **Saves time and cost** – Early testing prevents costly mistakes in later development.
✓ **Bridges the gap between idea and final product** – Provides a clear vision of the solution

Uses of the Prototype Stage

- 🔷 Used in **software development** to create wireframes or beta versions.
- 🔷 Applied in **engineering** to build working models of products.
- 🔷 Helps in **education** to test new learning methods before full-scale implementation.
- 🔷 Essential in **business innovation** to experiment with new services and experiences.
- 🔷 Supports **social innovation** by piloting solutions in real-world environments.

Types of Prototypes

1. **Low-Fidelity Prototypes** – Simple and quick representations (e.g., sketches, wireframes, paper models).
2. **High-Fidelity Prototypes** – More refined, functional models (e.g., clickable digital interfaces, working products).
3. **Mockups** – Visual representations that show the **look and feel** but lack functionality.
4. **Minimum Viable Product (MVP)** – A basic but functional version to test with users.

Procedural Steps for Prototyping

- 🔷 **Step 1: Define the goal** – Identify what aspect of the idea needs testing.
- 🔷 **Step 2: Select the prototype type** – Decide whether a **low-fidelity** or **high-fidelity** prototype is needed.
- 🔷 **Step 3: Build the prototype** – Create a **mock-up, wireframe, or working model**.
- 🔷 **Step 4: Test with users** – Gather feedback from students, instructors, or stakeholders.
- 🔷 **Step 5: Iterate and refine** – Make improvements based on real-world feedback.
- 🔷 **Step 6: Prepare for final implementation** – Move towards a **minimum viable product (MVP)**.

➢ **Example:**
For public transport, this could be a low-fidelity prototype, such as a simple app that shows bus arrival times based on manual inputs before integrating real-time tracking.

Stage 5: Test

- ➢ The test phase involves evaluating prototypes with real users to refine and improve the solution before final implementation.
- ➢ It focuses on gathering user feedback, identifying flaws, and iterating on the design to ensure it meets user needs effectively.
- ➢ Goal:
  - Validate the solution by testing it with real users.
  - Identify usability issues and areas for improvement.
  - Ensure the solution effectively addresses the problem statement.

➢ **Activities:**
- ❖ User Feedback Sessions: Observe how users interact with the prototype and collect their thoughts.
- ❖ Usability Testing: Assess how easily users can navigate and use the solution.

- ❖ Iterative Refinement: Modify the prototype based on user feedback to enhance functionality and user experience.

Importance of the Test Stage

✓ **Validates the solution** – Ensures that the final product meets user needs.
✓ **Reduces risks** – Prevents failures by refining weak points before full-scale launch.
✓ **Enhances user satisfaction** – Incorporates feedback to create a user-friendly experience.
✓ **Encourages iteration** – Allows continuous improvement through multiple testing rounds.
✓ **Saves time and cost** – Avoids expensive mistakes by fixing issues early.

Uses of the Test Stage

🔷 **Software development** – Beta testing apps and platforms before release.
🔷 **Product design** – Evaluating usability and functionality of physical products.
🔷 **Service design** – Testing customer interaction with services before implementation.
🔷 **Education technology** – Assessing the effectiveness of online learning platforms.
🔷 **Healthcare solutions** – Verifying efficiency of medical tools before use in real-world scenarios.

Methods of Testing

1. **Usability Testing** – Observing users as they interact with the prototype.
2. **A/B Testing** – Comparing two versions to see which performs better.
3. **Surveys & Feedback Forms** – Collecting structured responses from users.
4. **User Interviews** – Conducting in-depth discussions with testers.
5. **Field Testing** – Deploying the prototype in a real-world setting to see how it performs.

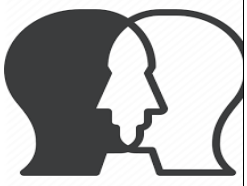
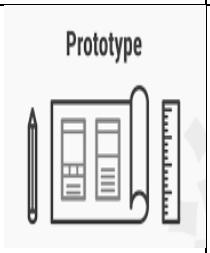
Example:

For the public transport system, testing could involve launching a pilot version of the bus-tracking app with a small group of commuters. Their feedback on accuracy, usability, and convenience would help refine the app before full deployment.

❖ In addition to the above mind sets views the following points are also considered for good designing thinking process

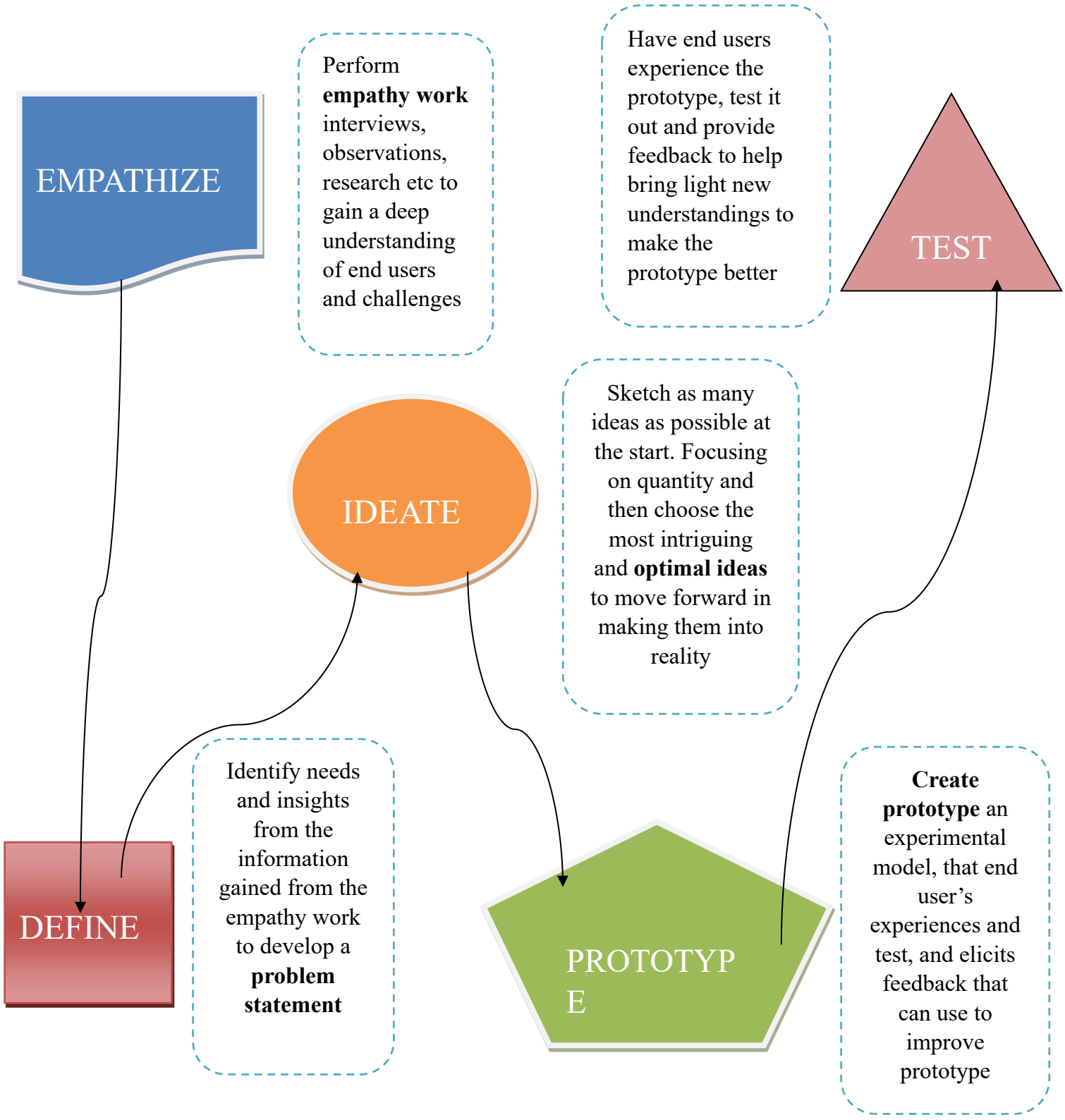
Those are

- Improve and learn from failure
- Creative confidence
- Growth mindset
- Beginner's mindset

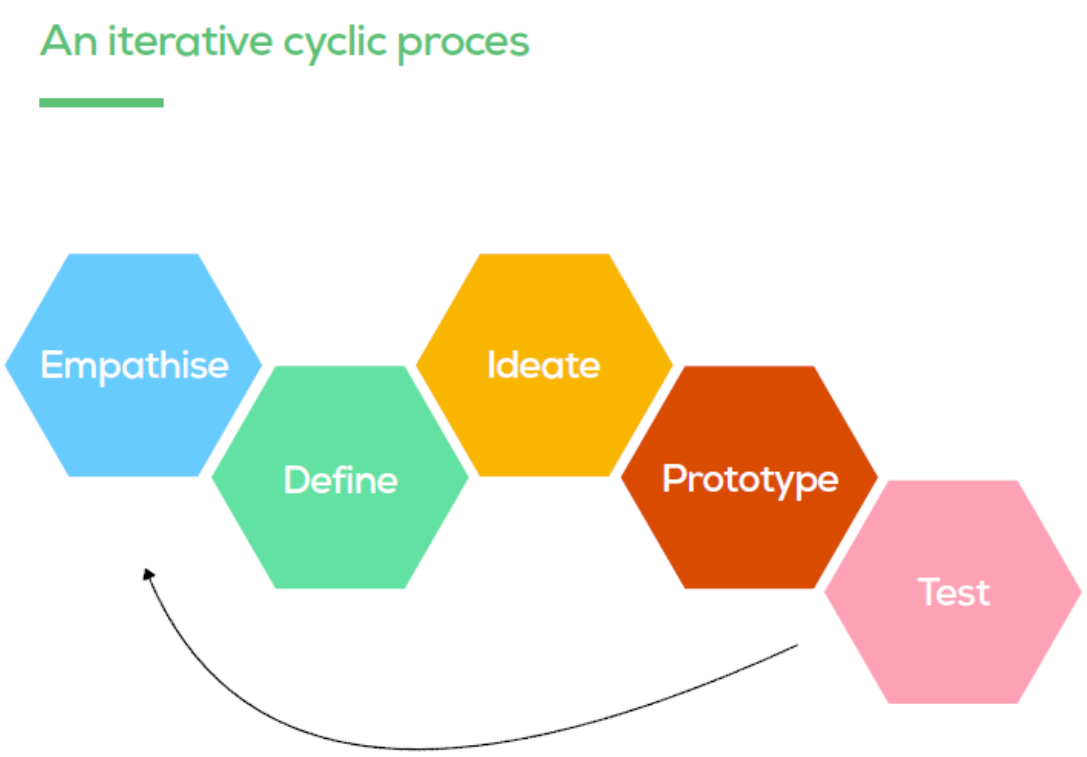
1	2	3	4	5	6
Empathize	Define	Ideate	Prototype	Te	Iterate
					

Supporting points of Stanford d school framework.

Design thinking is toolkit for creating problem-solving. The **process does not have to be linear**. It can jump from one phase to any other phase based on need.



Some more light on 5stage Stanford



2

Define

Process and synthesise the findings in order to form a user point of view that you will address

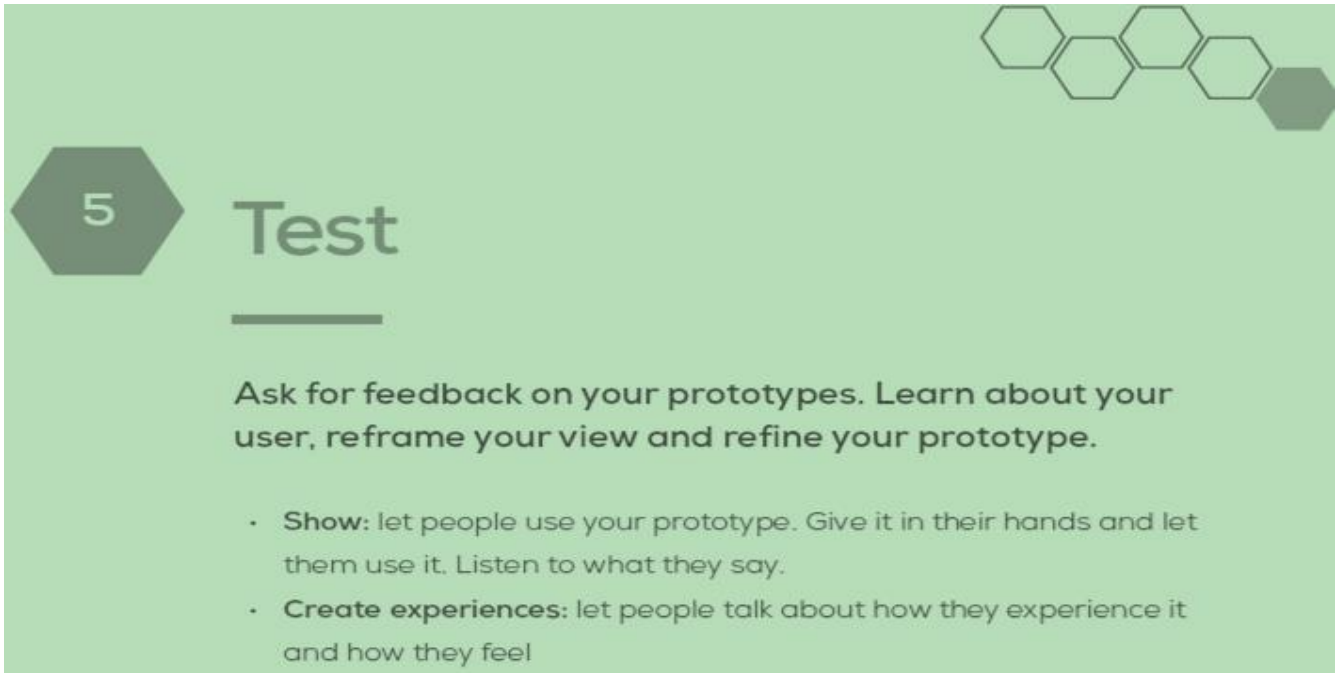
- **User:** develop an understanding of the type of person you are designing for
- **Needs:** synthesise and select a limited set of needs that you think are important to fulfil
- **Insights**: express insights you developed and define principles

3

Ideate

Focus on idea generation. You translate problems into solutions. Explore a wide variety and large quantity of ideas to go beyond the obvious solutions to a problem.

- **Creativity:** combine the un/conscious with rational thoughts and imagination
- **Group synergy:** leverage the group to reach out new ideas an build upon other's ideas
- Separate the generation and **evaluation** of ideas to give imagination a voice



2.2. Implementing the process in driving inventions

→ Design thinking can be a powerful tool for driving innovations in a variety of industries, particularly in engineering fields

→ Design thinking is a powerful framework that can be applied to drive innovation and invention across various fields

→ Let's discuss how the design thinking process can be applied to fuel the invention and innovation process in driving new products, technologies, and solutions.

1. **Empathize: Understanding User Needs:**
   - In the invention process, the most critical step is to deeply understand the problem from the perspective of the end-user
   - Empathy fuels innovation by ensuring that inventions target real user needs rather than theoretical ones.

- **Example**:
  For a new type of urban bicycle, empathy could involve spending time with city cyclists to understand their struggles with storage, theft, comfort, and navigating crowded streets.

2. **Analyze: Defining the Invention's Core Problem**
   - In this stage, insights from the empathy phase are organized and interpreted.
   - The goal is to clearly define the problem that the invention should address.

   - **Example**:
     In the case of urban bicycles, you might discover that theft prevention is a bigger problem than initially anticipated, pushing the invention toward creating a self-locking bike that integrates with city infrastructure

3. **Ideate: Brainstorming Potential Solutions**
   - In the ideation phase, teams brainstorm a range of creative solutions, no matter how outlandish
   - This is where innovation takes root, as ideas flow freely before being refined and selected.

   - **Example**:
     For the urban bike, ideas could range from GPS-enabled self-locking mechanisms to bikes with in-built solar panels to charge lights or other electronics.

4. **Prototype: Building Tangible Versions of Ideas**
   - Prototyping involves building a version of the invention to test how well it addresses the problem identified during analysis
   - Prototypes help in visualizing and testing the concept

   - **Example**:
     The prototype for the urban bike might be a 3D-printed model or a working bike with integrated GPS locks and solar panels to power small electronics like lights or a phone charger.

5. **Test: Evaluating the Prototype**
   - The final stage involves rigorous testing of the prototype, gathering user feedback, and making iterative improvements
   - . It often leads to revisiting earlier stages of the design thinking process, especially ideation and prototyping.

   - **Example**:
     The urban bike prototype might be tested by cyclists in a real-world setting to evaluate the GPS locking system’s effectiveness, durability, and ease of use. Feedback from users can then be incorporated to enhance the design

2.2.1. Real-World Example of Driving Inventions Using Design Thinking

i. Consider the invention of the modern smartphone

- ❖ The empathy stage involved understanding that users wanted a device that could do more than just make calls—people needed to manage emails, listen to music, and stay connected online.
- ❖ Analysing this need led to the problem definition: How can a single device handle communication, entertainment, and productivity?
- ❖ Ideation brought forth concepts like touchscreens and app ecosystems
- ❖ Prototyping involved early devices like the first iPhone, which was tested extensively before being released.
- ❖ The result was a product that revolutionized communication.

ii. The Invention of the Dyson Air Multiplier

Empathize:	Dyson's engineers recognized the frustration users experienced with traditional fans, which often produced noisy blades and disrupted airflow. They conducted extensive research to understand user needs and pain points.
Define:	Based on their research, Dyson defined the problem as the need for a fan that was quiet, efficient, and produced a powerful, uninterrupted airflow
Ideate:	Through brainstorming and experimentation, Dyson's engineers explored various concepts for a new type of fan. They considered different airflow patterns, materials, and mechanisms.
Prototype	Dyson created numerous prototypes to test their ideas and refine the design. They experimented with different materials, shapes, and sizes to optimize performance and aesthetics.
Iterate and Refine:	The design thinking process is iterative, meaning that inventors often need to revisit previous stages to refine their ideas and address challenges. Dyson continued to

	iterate on their prototypes until they achieved the desired performance and user experience.

2.2.2. Key Strategies for Implementing Design Thinking in Inventions:

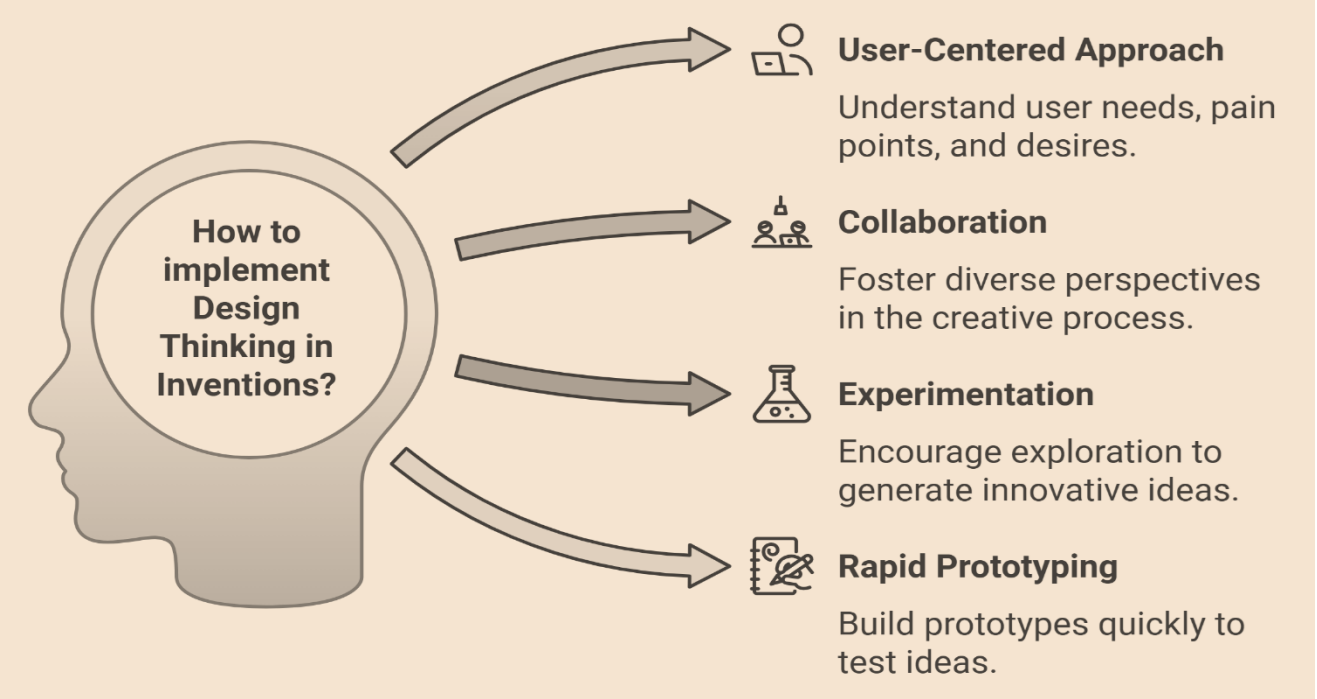
User-Centered Approach: Always keep the user at the center of the design process. Understand their needs, pain points, and desires.

Collaboration: Foster a collaborative environment where diverse perspectives can contribute to the creative process.

Experimentation: Encourage experimentation and exploration to generate innovative ideas.

Rapid Prototyping: Build prototypes quickly to test ideas and gather feedback.

Iteration: Be prepared to iterate on your designs based on feedback and new insights.



2.2.3. Additional Tips for Driving Inventions:

- **Leverage Diverse Teams:** Teams with diverse backgrounds and expertise can bring fresh perspectives to problem-solving.
- **Utilize Design Thinking Tools:** Tools like mind mapping, empathy maps, and journey maps can help visualize the design process.
- **Seek Inspiration:** Look for inspiration in unexpected places, such as nature, art, or other industries.
- **Protect Your Intellectual Property:** Once you have a promising invention, consider patenting it to protect your rights.

2.3. Design thinking in social innovations

→ Design thinking is a transformative approach that not only drives technological and business innovations but also serves as a powerful tool for creating impactful social innovations

→ Social innovation refers to new strategies, ideas, products, and services designed to address pressing social issues, such as poverty, education, healthcare, and sustainability.

→ Using design thinking in social innovation allows for empathetic, user-centered solutions that can bring meaningful change to communities, especially by understanding the needs of marginalized or underserved groups.

Example:

1. **Empathize: Understanding the Community's Needs**
   - Empathy is the cornerstone of social innovation. This stage requires immersing oneself in the community to deeply understand their struggles, aspirations, and needs
   - Social innovators must observe, interact, and engage with the people who are affected by the issues they aim to solve.
   - In working on a solution to improve access to clean drinking water in rural areas, empathizing would involve visiting the community, talking to families, and observing their daily routines to understand the challenges they face in accessing clean water

2. **Analyze: Defining the Core Problem**
   - The analysis phase synthesizes all the information collected during the empathy stage. This step is crucial for clearly defining the problem that needs solving
   - In social innovation, the problems are often complex and multi-faceted, so defining the right problem is key to creating sustainable solutions.
   - After observing rural communities, you might realize that while water scarcity is a concern, the main issue is contamination due to poor sanitation practices, not just lack of water infrastructure.

3. **Ideate: Brainstorming Creative Solutions**
   - The ideation phase allows innovators to generate numerous ideas, without restrictions, for how to address the social issue
   - The focus is on creativity and thinking beyond conventional solutions. In social innovation, ideation might involve the collaboration of multiple stakeholders, such as community leaders, social workers, and engineers.
   - For improving access to clean drinking water, ideation might lead to solutions such as building decentralized water filtration systems, rainwater harvesting structures, or low-cost, easy-to-maintain water filters.

4. **Prototype: Building Tangible Solutions**
   - Prototyping in social innovation is about turning ideas into tangible solutions, testing how well they address the community’s needs

- Prototypes in this context don't need to be high-tech but must be practical, affordable, and accessible for the communities involved.
- A prototype for clean water access might be a simple gravity-based filtration system, using locally sourced materials like sand and charcoal, which can be tested with a small group of households.

5. **Test: Evaluating and Refining Prototypes**
    - The testing phase allows for gathering feedback from real users, assessing how well the prototype solves the problem, and making necessary refinements
    - In social innovation, this phase is vital because it ensures that the solution is not only effective but also culturally appropriate and sustainable in the long run.
    - The clean water filtration system could be tested in various households for a month, with regular feedback collected on water quality, ease of use, and maintenance. The design can be refined based on how well the prototype performs in real-world conditions.

2.4 Tools of design thinking - persona, costumer, journey map, brainstorming,

2.4.1. Persona:

→ Definition:
- A **persona** is a fictional character that represents a specific user group or audience

→ Personas are based on real data and insights gathered through empathy exercises, including interviews, surveys, and observations.

→ The goal is to create a clear, relatable representation of the user, making it easier to design solutions that meet their needs

→ A detailed representation of a typical user, based on research and data

→ A persona is a detailed and fictional representation of a user archetype. It emb odies the characteristics, needs, behaviors, and goals of a typical user.

→ **Why Use Personas?**
- Personas bring focus to design by grounding decisions in real user needs and behaviours.
- They prevent teams from designing for a vague, generalized user and instead help target solutions for specific, relatable individuals

Purpose:

- Helps in understanding user needs, behaviours, and motivations.
- Ensures products and services are designed with the end-user in mind.
- Creates alignment among teams (designers, developers, marketers, etc.).

General Template of Persona:

		Image
1	**Persona Name:** [Give the persona a fictional name]	
2	**Demographics:** [Age, Gender, Occupation, Location, etc.]	
3	**Background:** [Brief background information about the persona]	
4	**Goals:** [The primary goals and aspirations of the persona]	
5	**Needs:** [The key needs and desires of the persona]	
6	**Challenges:** [The obstacles or challenges the persona faces]	
7	**Attitudes:** [The persona's attitudes, beliefs, and values]	
8	**Behaviors:** [Typical behaviors and habits of the persona]	
9	**Technology Use:** [The persona's familiarity and comfort with technology]	
10	**Transportation Habits:** [How the persona commutes and uses public transportation]	
11	**Family:** [Family status, if relevant]	
12	**Interests/Hobbies:** [The persona's hobbies or interests]	
13	**Communication Preferences:** [Preferred methods of communication for the persona]	
14	**Key Insights:** [Key insights or quotes from research that inform the persona]	

Example:

Context is **Engineering student attending online e classes**

		Image
1	**Persona Name:** [Give the persona a fictional name]	Rahul (say)
2	**Demographics:** [Age, Gender, Occupation, Location, etc.]	Age**:** 20 Gender**:** Male Occupation**:** Engineering Student (3rd Year) Location**:** Vijayawada, India
3	**Background:** [Brief background information about the persona]	Pursuing a bachelor's **degree in Mechanical Engineering**. Attends **online lectures due to hybrid learning policies**. Lives in a **shared apartment with roommates** near the college. Prefers **self-paced learning** but finds online classes challenging at times
4	**Goals:** [The primary goals and aspirations of the persona]	Understand **complex engineering concepts effectively** through online learning. Maintain **good academic performance** and secure an internship. Stay **updated with new technologies** like AI and IoT.
5	**Needs:** [The key needs and desires of the persona]	Reliable **internet connection** to avoid disruptions in online classes. Interactive **learning materials** (videos, animations, simulations). A **structured schedule** for self-study and assignment deadlines. Easy **access to recorded lectures** for revision.
6	**Challenges:** [The obstacles or challenges the persona faces]	Difficulty **focusing** due to distractions at home. Lack **of hands-on experience** in labs during online learning. Technical **issues** like poor internet connectivity or software crashes. Struggles with **long screen time** causing eye strain
7	**Attitudes:** [The persona's attitudes, beliefs, and values]	Motivated to learn but **prefers practical applications over theory**. Believes **peer discussions** help in better understanding. Open to **new digital learning tools** but needs guidance in using them.
8	**Behaviors:** [Typical behaviors and habits of the persona]	Joins **live online lectures** but sometimes **watches recordings later**.

		□ Takes notes using **digital tools like OneNote and Notion**. □ Participates in **online forums and WhatsApp groups** for doubts.
9	**Technology Use:** [The persona's familiarity and comfort with technology]	□ Uses a **laptop for attending online classes** and completing assignments. □ Prefers **Google Meet, Zoom, and Microsoft Teams** for virtual learning. □ Uses **YouTube and Coursera** for additional learning resources
10	**Transportation Habits:** [How the persona commutes and uses public transportation]	□ Usually stays indoors due to online classes. □ Use a **bike or public transport** when attending offline practical.
11	**Family:** [Family status, if relevant]	□ Lives away from family for studies but stays connected through calls. □ Parents support education but have **limited understanding of online learning**.
12	**Interests/Hobbies:** [The persona's hobbies or interests]	□ Passionate about **robotics and 3D printing**. □ Enjoys **gaming and coding in Python**. □ Admire **watching tech-related YouTube videos**.
13	**Communication Preferences:** [Preferred methods of communication for the persona]	□ Prefers **email for official academic communication**. □ Uses **WhatsApp and Telegram** for quick discussions with classmates. □ Engages in **LinkedIn for professional networking**
14	**Key Insights:** [Key insights or quotes from research that inform the persona]	□ "I need a **structured way to stay engaged** in online classes without distractions." □ "Access to **hands-on virtual labs** would make online learning more effective." □ "Good internet and **recorded lectures help in better understanding** topics."

How Persona is Connected to the Empathize Stage in Design Thinking:

1. Understanding User Needs (Empathize Stage)

- The **Empathize** stage in **Design Thinking** focuses on understanding the users' emotions, behaviours, and challenges.
- Personas are created based on **real user research** (interviews, surveys, observations), making them a key tool in this stage.

2. Role of Personas in the Empathize Stage

Personas help design teams:

✅ **Step into the users' shoes** to see the world from their perspective.

✅ Identify **pain points and frustrations** that need solutions.

✅ Understand **motivations, behaviours, and expectations** of users.

✅ Create **human-centered solutions** rather than assumptions-based ones.

Let's take the example of **Rahul the engineering student** attending online classes:

- **Without Empathy**: Assume all students have a stable internet connection and focus only on delivering content.
- **With Empathy & Persona**: Recognize that some students struggle with distractions, lack hands-on experience, and need recorded lectures for better understanding.
- **Outcome**: The design team can create solutions like **interactive simulations, better online engagement methods, and offline access options**

Conclusions:

- Personas **are a direct outcome of the Empathize stage**, as they summarize research insights into a relatable character.
- They **guide ideation, prototyping, and testing** by ensuring solutions truly meet user needs.
- A well-defined persona **bridges the gap between research and actionable design decisions**.

2.4.2. Empathy Mapping

Definition.

- An **Empathy Map** is a visual tool used to understand a user's thoughts, feelings, behaviours, and pain points.
- It helps teams **gain deeper insights** into their target audience and improve user-centered design.
- Developed by **Dave Gray**, it is widely used in **Design Thinking, UX design, and product development**

Characteristics of an Empathy Map

- ❖ Focuses on understanding users' emotions and actions
- ❖ Encourages cross-functional team discussions.
- ❖ Uses a **six-quadrant** layout for easy analysis.
- ❖ Derived from **real user data**, not assumptions.
- ❖ Can be **updated** as new insights emerge
- ❖ It is not chronological or sequential.
- ❖ There is one empathy map for each persona or user type (1:1 mapping)

Significance of Empathy Mapping

- **Enhances User Understanding** – Helps designers empathize with users.
- **Identifies Pain Points** – Highlights user frustrations for better problem-solving.

- **Guides Decision-Making** – Supports ideation and product refinement.
- **Bridges Gaps in Assumptions** – Avoids bias and ensures user-focused design.
- **Improves Team Alignment** – Creates a **shared understanding** among stakeholders

Purpose of Empathy Mapping

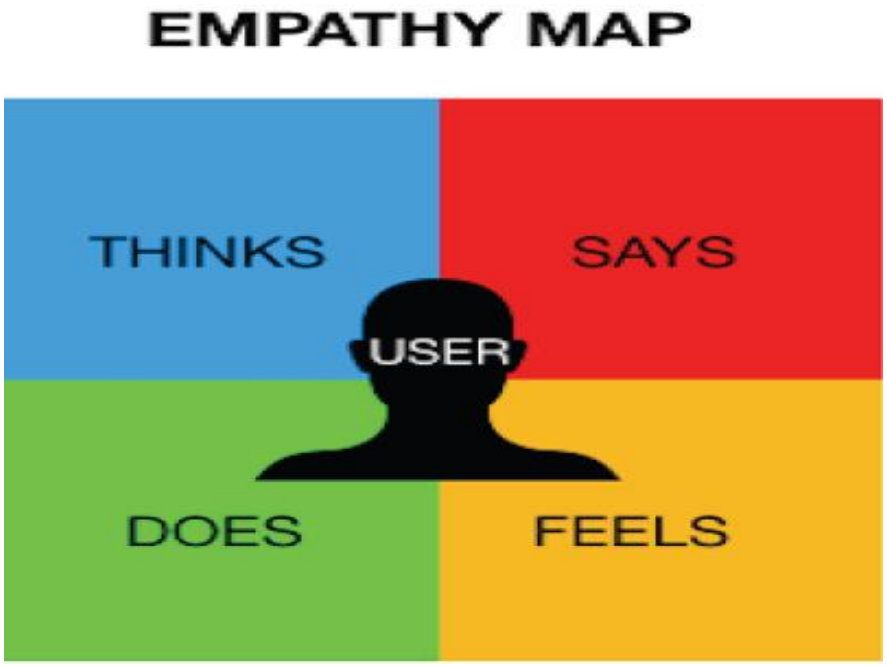
🎯 **Understanding the user's perspective** in a structured way.
🎯 **Creating user personas** for product and service design.
🎯 **Enhancing UX design** by addressing real user pain points.
🎯 **Helping in customer journey mapping** and design ideation.
🎯 **Ensuring emotional connection** between users and solutions.

Uses of Empathy Mapping

📌 **Design Thinking & Innovation** – Used in the **Empathize Stage**.
📌 **Product Development** – Helps design **intuitive and user-friendly** products.
📌 **Marketing & Branding** – Improves **customer engagement strategies**.
📌 **Service Design** – Enhances **customer experience** in services.
📌 **UX/UI Design** – Helps in **interface design & interaction improvements**.

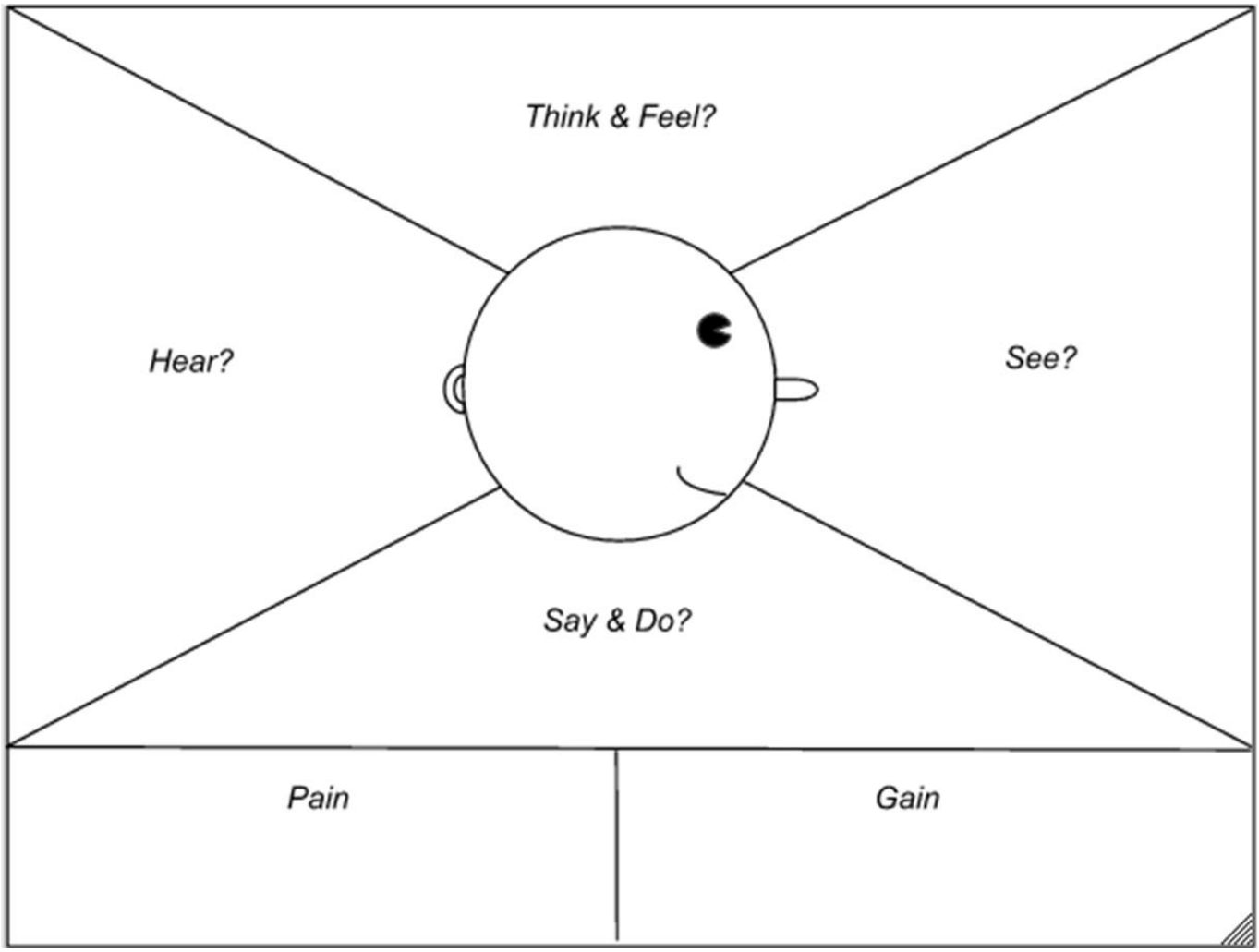
- Traditional empathy maps are spilt into **four** quadrants

- **The four quadrants are says, Thinks, Does and Feels with the user or persona in the middle.**



→ To **Get the more comprehensive understanding of user's experience** include **see, hear, pain and gain components**, then the enhanced map is as below

General Template of Enhanced Empathy Map:



Explanation of Map components:

Component of Map	Representation	Outcome of the component
See	Observations and Environment	**What the user observes in their surroundings** ✓ Visual elements that shape their experiences and decisions ✓ External factors influencing their perceptions.
Hear	Sounds and auditory cues	**What the user hears from others** ✓ friends, colleagues, media, influencers, etc. ✓ Verbal input that affects their thoughts and decisions. ✓ Cultural or social influences on their behaviour.
Think	Internal thoughts	**Unspoken thoughts, doubts, and concerns.** ✓ What the user is thinking but may not say out loud
Feel	Emotion and experience	**feel about their current challenges and solutions** ✓ Emotional states, frustrations, and joys.
Says	Verbal Expressions	**Direct quotes from the user.** ✓ What they express in conversations, interviews, or surveys

Do	Action and Behaviour	**Observable actions and habits.** ✓ How the user interacts with the product/service
Pain	Challenges and Frustrations	**Key obstacles the user faces.** ✓ What makes their experience difficult or unpleasant
Gain	Opportunities and benefits	**Positive aspects of their experience.** ✓ What helps them and what they appreciate

Procedural Steps for Filling an Empathy Map Template:

Step-1: Define the User Persona – Identify who the user is and their background

Step-2: **Conduct Research** – Use surveys, interviews, and observations

Stpe-3: Organize Insights – Sort user feedback into the **six categories** (see, hear, Says& Does, Think &Feel, Pain Points, Gain Points).

Step-4: Analyze Patterns – Look for common trends in user behaviour

Step-5: Use Findings for Design Decisions – Apply insights to improve user experience and solve pain points.

Example:

Empathy Mapping for attending online classes:

User Persona: Rahul Sharma – 3rd Year Engineering Student

📌 **Background:**

- Rahul is a **third-year mechanical engineering student** attending online classes.
- He **prefers structured learning** but **struggles with distractions, technical issues, and lack of practical exposure**

Category	Details
🧐 **SEE (Visual Perception)**	📌 Sees a cluttered online learning interface with multiple tabs open for study materials. 📌 Notices **black screens** of classmates who don't turn on their cameras, making the class feel impersonal. 📌 Sees **slow-loading pages** due to internet issues. 📌 Notices **inconsistent engagement** from both students and professors.
👂 **HEAR (Auditory Experiences)**	📌 Hears **monotonous lectures** with little interaction. 📌 Experiences **background noise and disturbances** from unmuted microphones. 📌 Listens to **professors struggling with technology** (mic issues, screen sharing problems). 📌 Relies on **WhatsApp and Telegram study groups** for discussions.

🗣 **SAYS (Verbal Expressions)**	📌 "I need a **structured schedule** for my online classes." 📌 "Internet issues **make it hard** to follow live lectures." 📌 "I prefer **recorded sessions** for revision." 📌 "I **miss classroom interactions** with friends and professors."
💭 **THINKS (Internal Thoughts)**	📌 "I **wish online classes were as interactive** as offline ones." 📌 "How can I **manage time better** with so many assignments?" 📌 "I **feel disconnected** from my classmates." 📌 "Will **online learning affect my job prospects**?"
🚀 **DOES (Actions & Behaviours)**	📌 Joins online classes but **gets distracted easily**. 📌 Takes **notes using digital tools** (OneNote, Notion). 📌 Watches **YouTube tutorials** for better understanding. 📌 Participates in **WhatsApp/Telegram study groups** for doubt-solving.
😣 **PAIN POINTS (Challenges & Frustrations)**	📌 **Frequent distractions** while studying at home. 📌 **Internet connectivity issues** disrupt learning. 📌 **Lack of practical exposure** in online learning. 📌 **Difficulty staying engaged** in long online sessions. 📌 **Screen fatigue** from excessive digital learning.
🎯 **GAIN POINTS (Opportunities & Benefits)**	📌 **Access to recorded lectures** for revision. 📌 **Flexible learning schedule** allows self-paced study. 📌 **Exposure to global courses** & additional learning platforms (Coursera, Udemy, etc.). 📌 **Saves commuting time**, allowing more focus on assignments. 📌 **Digital tools** like Notion and Google Drive **help in organization**.

Key Takeaways from Rahul's Empathy Map

✅ **Challenges Rahul Faces:**
Frequent **distractions and internet issues** disrupt the learning experience.
✓ **Lack of practical exposure** makes engineering subjects harder to grasp.
✓ **Online learning feels isolating**, with **limited interaction** and **monotonous lectures**.

✅ **Opportunities for Improvement:**
✓ **Recorded lectures and digital learning tools** help improve understanding.
✓ **Self-paced learning** allows Rahul to study at his convenience.
✓ **Gamified and interactive learning methods** (like virtual labs and real-time discussions) can make online education more engaging.

2.4.3. Customer journey map

→ **Definition:**
- A **Customer Journey Map** is a visual representation of the user's interaction with a product or service, from initial contact to final outcome

→ It helps identify pain points, opportunities, and key touchpoints in the user's experience, enabling designers to improve the journey.

→ A visual representation of a customer's interaction with a product or service from start to finish.

→ A customer journey map visualizes the steps a user takes to achieve a goal, hig hlighting their experiences, touchpoints, and pain points.

→ **Why Use Journey Maps?**
- Journey maps reveal gaps between the user's expectations and actual experience, allowing designers to empathize with users and address pain points more effectively

→ **Components of a Journey Map**
- **Stages**: Key phases the user goes through (e.g., awareness, consideration, purchase, use).
- **Touchpoints**: Where and how the user interacts with the product/service.
- **Emotions**: The user's feelings during each stage, whether positive, neutral, or negative.
- **Pain Points**: Moments where the user experiences frustration or difficulty.
- **Opportunities**: Areas where improvements or innovations can enhance the experience

→ **Example of a Customer Journey Map**
- Mapping the journey of someone booking a flight online, from researching prices to the experience at the airport

Characteristics of Customer Journey Mapping

- **User-Centric** – Focuses on the customer's experience rather than internal processes.
- **Chronological** – Maps interactions **step by step** in a logical sequence.
- **Data-Driven** – Based on **real user research**, not assumptions.
- **Cross-Functional** – Involves multiple departments (design, sales, marketing, customer service)
- **Iterative** – Can be **updated over time** as new insights emerge.

Significance of Customer Journey Mapping

- **Enhances User Experience (UX)** – Helps improve touchpoints for a smoother journey.
- **Identifies Gaps & Pain Points** – Reveals where users face difficulties.

- **Improves Customer Retention** – Helps in **reducing friction** and making services more user-friendly.
- **Aligns Teams & Processes** – Ensures all stakeholders understand the customer's perspective.
- **Optimizes Product & Service Design** – Helps businesses build solutions **tailored to user needs**.

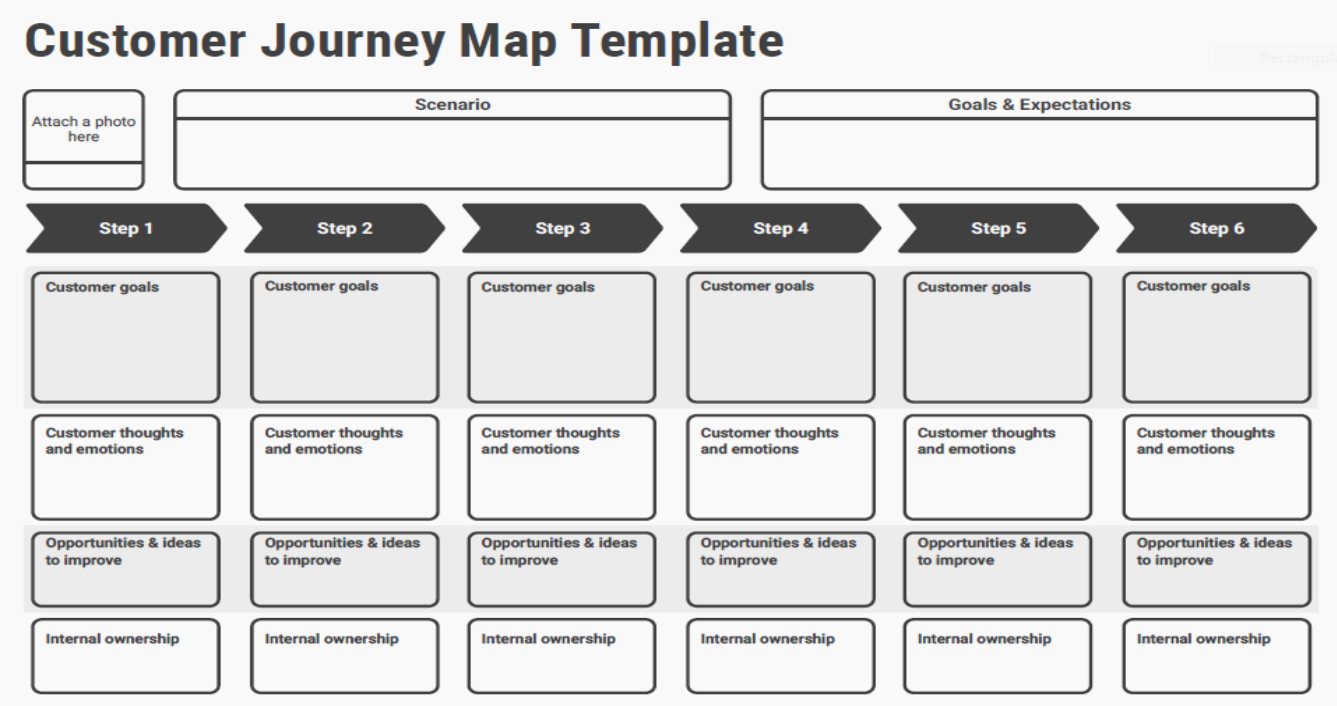
Purpose of Customer Journey Mapping

- To understand customer behaviour and decision-making patterns.
- To improve customer satisfaction and reduce frustrations.
- To identify key moments that impact a customer's perception of a product/service.
- To refine and optimize business processes for a seamless user experience.

Uses of Customer Journey Mapping

→ **Product Development** – Helps create user-friendly designs.
→ **Marketing Strategy** – Identifies where and how to communicate with users.
→ **Service Improvement** – Enhances customer support and interaction.
→ **Sales & Customer Retention** – Improves conversion rates and brand loyalty.
→ **Digital Experience Optimization** – Helps improve apps, websites, and online platforms

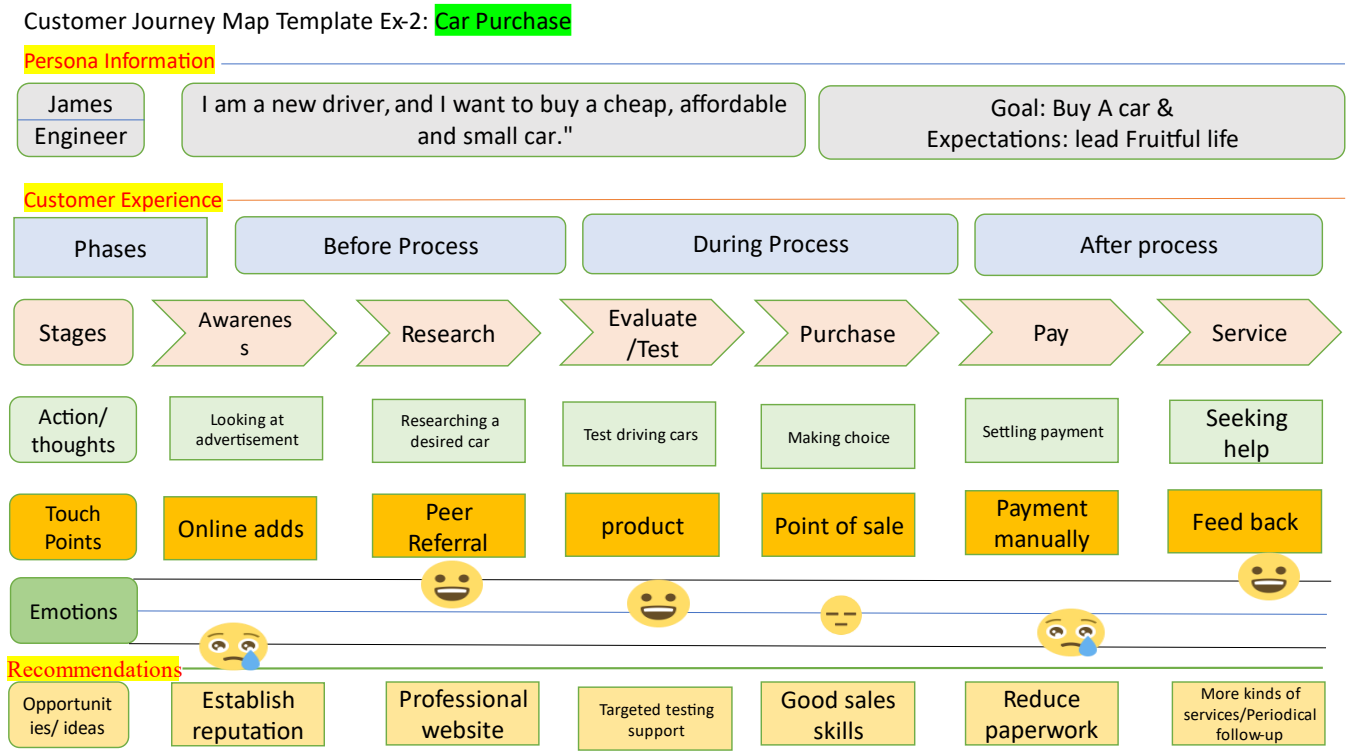
General Template of a Customer Journey Map



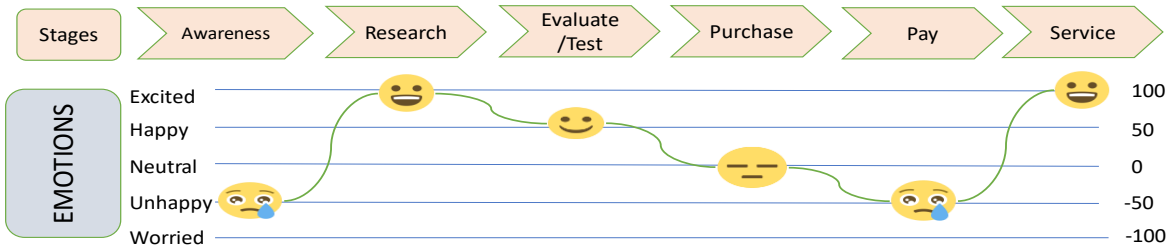
Procedural Steps for Filling a Customer Journey Map Template

- Step 1: Define the user persona (Who is the customer?)
- Step 2: Identify customer goals and motivations at each stage.
- Step 3: List touchpoints where the user interacts with the product/service.
- Step 4: Analyze customer emotions (positive or negative).
- Step 5: Identify pain points and challenges.
- Step 6: Suggest opportunities for improvement.
- Step 7: Validate the journey with real user data and refine accordingly

Example:



Special Focus on Emotional Curve:



NOTE:

- Before Generate Customer -Journey Map Designer Must study or observed and collect the data of Each stage from the user
- Emotional Rating is decided by designer based on the user data and feed back

Implement the Stanford 5 stages to Attending online class example:

Stage-1: Empathy

Here the pain points are identified by persona, empathy mapping and customer journey map

The major pain points are:

❌ Technical issues (slow internet, platform glitches)

❌ Lack of engagement (passive learning, no hands-on experience)

❌ Stressful assessments (unclear grading, lack of feedback)

❌ Isolation (no peer interaction, no collaboration)

Stage -2: Define or analyze

Problem Statements Using HMW:

1. **Technical Challenges**

🔷 HMW make online learning platforms more accessible and user-friendly for engineering students facing technical difficulties?

2. **Lack of Engagement**

🔷 HMW design more interactive and hands-on learning experiences for online engineering students to maintain their motivation?

3. **Assessment Stress**

🔷 HMW provide real-time feedback and fair grading in online assessments to reduce students' stress?

4. **Student Isolation**

🔷 HMW create a collaborative online learning environment where students can engage with peers and faculty more effectively?

Final Problem Statement:

"Engineering students attending online classes struggle with technical difficulties, lack of engagement, stressful assessments, and social isolation, leading to frustration, reduced motivation, and ineffective learning experiences."

Stage-3: Ideate

After defining the **problem statement**, the **HMW** questions serve as starting points for brainstorming.

1. Technical Challenges

HMW make online learning platforms more accessible and user-friendly for engineering students facing technical difficulties?

💡 Possible Ideas:

- **AI-driven adaptive streaming** (adjusts video quality based on internet speed).
- **Offline learning options** (downloadable lecture notes & videos).
- **Simplified, lightweight learning platforms** (low-data consumption).

2. Lack of Engagement

HMW design more interactive and hands-on learning experiences for online engineering students to maintain their motivation?

💡 Possible Ideas:

- **Virtual labs & simulations** for practical learning.
- **Gamified learning experiences** (badges, leaderboards, interactive quizzes).
- **Live Q&A sessions** with instructors & industry experts.

3. Assessment Stress

HMW provide real-time feedback and fair grading in online assessments to reduce students' stress?

💡 Possible Ideas:

- **AI-based grading with instant feedback** on assignments.
- **Peer-reviewed assignments** for collaborative learning.
- **Multiple assessment formats** (project-based, open-book, oral exams).

4. Student Isolation

HMW create a collaborative online learning environment where students can engage with peers and faculty more effectively?

💡 Possible Ideas:

- **Virtual study groups & discussion forums** for teamwork.
- **Collaborative projects using online whiteboards & coding platforms**.
- **AI-driven mentor matching** for personalized academic guidance.

Final Idea Selection:

After brainstorming, the most **feasible and impactful ideas** are:

✅ **AI-driven adaptive learning** for better accessibility.
✅ **Gamification & virtual labs** for engagement.
✅ **Real-time AI-based feedback & peer reviews** for stress-free assessment.
✅ **Collaborative tools & discussion platforms** for reducing isolation.

Stage-4: prototype

Prototype 1. AI-Driven Adaptive Learning Platform

🔷 **Low-Fidelity Prototype:**

- A **wireframe or mock-up** showing an AI-powered **dashboard** that adjusts video quality, suggests resources, and provides offline downloads.

🔷 **High-Fidelity Prototype:**

A **beta version** of the learning platform with an **AI chatbot** for support and a **low-bandwidth mode** for poor internet connections

Prototype 2. Gamification & Virtual Labs for Engagement

🔷 **Low-Fidelity Prototype:**

- A **storyboard or flowchart** showing how a gamified system would work (e.g., badges, leaderboards, challenges).

🔷 **High-Fidelity Prototype:**

- A **clickable prototype of a virtual lab** that allows students to interact with 3D models and simulations of engineering experiments.

Prototype 3. AI-Based Feedback & Peer Review System

🔷 **Low-Fidelity Prototype:**

- A **mock-up of an AI-assisted grading dashboard** showing **automated feedback** on assignments and a peer review system.

🔷 **High-Fidelity Prototype:**

- A **functional prototype of an AI assessment tool** that evaluates code, essays, and projects with **real-time feedback**.

Prototype 4. Collaborative Discussion & Mentorship Platform

🔷 **Low-Fidelity Prototype:**

- A **sketch of a discussion board with AI mentor matching**.

🔷 **High-Fidelity Prototype:**

- A **beta version of a virtual collaboration space** where students can **form study groups, share notes, and connect with mentors**.

Stage-5: Test

Test 1.AI-Driven Adaptive Learning Platform

🔷 **Test Method: Usability Testing & Surveys**
🔷 **Test Process:**

- Select a group of engineering students with varying internet connectivity.
- Ask them to navigate the AI-powered learning dashboard.
- Collect feedback on **usability, accessibility, and adaptability**.
  🔷 **Key Metrics to Measure:**
  ✅ Ease of navigation
  ✅ Accuracy of AI suggestions
  ✅ Performance in low-bandwidth conditions

Test 2. Gamification & Virtual Labs for Engagement

🔷 **Test Method: A/B Testing & Field Testing**
🔷 **Test Process:**

- Create two groups: one using traditional online lectures and one using **gamified learning with virtual labs**.
- Compare **engagement, completion rates, and performance**.
  🔷 **Key Metrics to Measure:**
  ✅ Student interaction levels
  ✅ Knowledge retention improvement
  ✅ User experience feedback

Test 3. AI-Based Feedback & Peer Review System

🔷 **Test Method: User Interviews & Surveys**
🔷 **Test Process:**

- Ask students to submit assignments using the **AI grading system**.
- Collect feedback on **grading accuracy, fairness, and speed**.
  🔷 **Key Metrics to Measure:**
  ✅ Satisfaction with AI feedback
  ✅ Speed of grading compared to manual evaluation
  ✅ Peer review effectiveness

Test 4. Collaborative Discussion & Mentorship Platform

🔷 **Test Method: Field Testing & User Interviews**
🔷 **Test Process:**

- Enable engineering students to **use the discussion platform for a semester**.

- Observe how frequently they interact with mentors and peers.

🔷 **Key Metrics to Measure:**

✅ Number of student-mentor interactions

✅ Improvement in problem-solving discussions

✅ User satisfaction with the mentorship system

2.5. Brainstorming

Definition:

- **Brainstorming** is a creative technique used to generate a wide range of ideas in a group setting.

→ The objective is to encourage free thinking and open-mindedness, allowing team members to propose unconventional solutions without fear of judgment.

→ A creative technique for generating a large number of ideas in a short period of time.

→ Brainstorming is a collaborative technique for generating a large number of id eas in a short amount of time.

→ Helps designers explore different possibilities and find innovative solutions.

→ **Why Use Brainstorming?**

- Brainstorming fosters collaboration and helps break mental blocks, enabling the generation of diverse and innovative ideas. It's an essential part of the ideation phase in design thinking.

Rules of Effective Brainstorming

- **Defer Judgment**: No idea is too crazy criticism can stifle creativity.
- **Encourage Wild Ideas**: The more creative or unconventional, the better.
- **Build on the Ideas of Others**: Use one idea as a stepping stone to another.
- **Stay Focused on the Topic**: Keep the brainstorming session goal oriented.
- **Quantity over Quality**: Generate as many ideas as possible before narrowing them down.

Types of Brainstorming:

. **A. Individual Brainstorming**

- 🔷 **Conducted alone** – No external influence or pressure.

  🔷 Used for **personal ideation, creative writing, and academic research**.

B. Group Brainstorming

- 🔷 **Collaborative session** where multiple people share ideas.

  🔷 Effective for **business meetings, product development, and workshops**.

C. Structured Brainstorming

- 🔷 **Follows a clear process** with defined rules and time limits.
- 🔷 Used in **corporate settings and formal design thinking sessions**.

D. Unstructured Brainstorming

- 🔷 **Open-ended, free-flow discussion** without rigid rules.
- 🔷 Encourages **spontaneity and out-of-the-box thinking**.

E. Reverse Brainstorming

- 🔷 Instead of finding **solutions**, participants find **ways to worsen a problem** and then reverse them into solutions.
- 🔷 Useful for **risk assessment and problem analysis**.

F. Rapid Ideation

- 🔷 Participants generate **ideas quickly** within a limited time.
- 🔷 Helps prevent **overthinking and enhances creativity**.

How to Conduct a Brainstorming Session?

Step 1: Define the Problem Statement

- Use a **"How Might We"** (HMW) statement.
- Example: **"How might we improve the engagement of engineering students in online classrooms?"**

Step 2: Set Clear Objectives

- ✓ What do you want to achieve?
- ✓ Who will participate?
- ✓ How will the ideas be evaluated?

Step 3: Gather a Diverse Team

- ✓ Include people with **different backgrounds and perspectives**.
- ✓ Ideal team size: **5-10 participants**.

Step 4: Establish Brainstorming Rules

- ✓ No criticism of ideas.
- ✓ Encourage **wild and unconventional thoughts**.
- ✓ Focus on **quantity over quality** initially.
- ✓ Build on others' ideas.

Step 5: Conduct the Session

- ✓ Use **sticky notes, whiteboards, or digital tools**.
- ✓ **Set a time limit** (e.g., 15-30 minutes).
- ✓ Ensure a **facilitator** guides the discussion.

Step 6: Categorize & Prioritize Ideas

- ✓ Group similar ideas together.
- ✓ Use **affinity mapping or mind mapping** to visualize concepts.

Conclusion on tools:

- ❖ By using these tools effectively, designers can create products, services, and solutions that resonate deeply with the people they are intended to serve.
- ❖ These tools are versatile and can be applied across various engineering disciplines
- ❖ These tools are often used together to create a comprehensive understanding of users and their needs
- ❖ By working together, these tools can help designers develop innovative and user-centered products and services.
- ❖ These tools are crucial for ensuring your innovations are user-centered and address real needs effectively

2.6. Product development

→ **Definition:**

- **Product development** is the process of creating a new product or service that meets the needs of a target market

→ Product development is a structured process for creating new products or improving existing ones

→ . It involves a series of steps from ideation to launch, and requires careful planning, research, and execution

Key Stages of Product Development

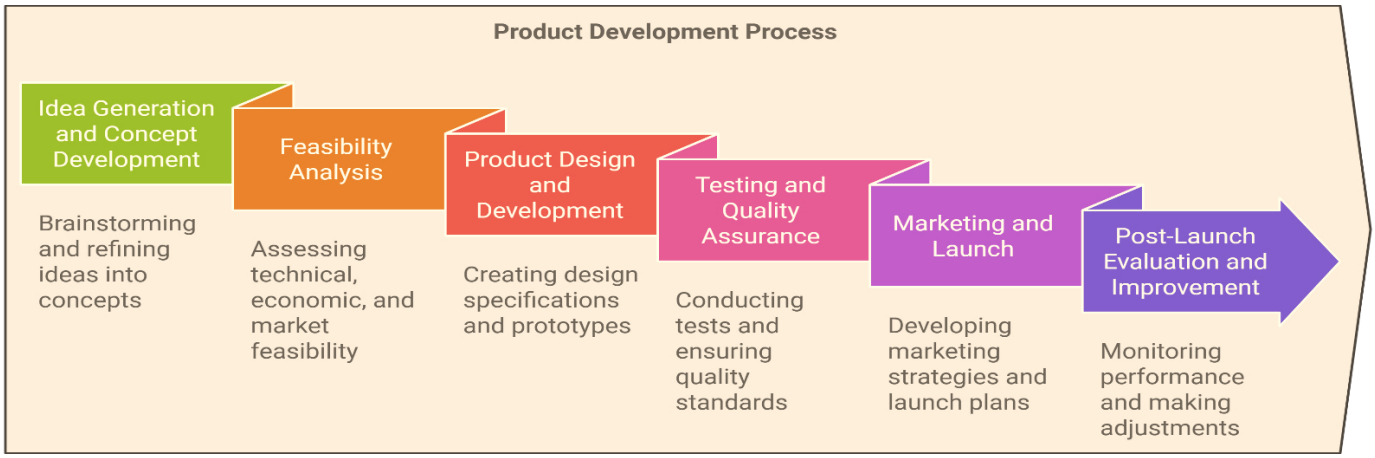
1. **Idea Generation and Concept Development:**
   - **Brainstorming:** Generate a variety of ideas through individual or group brainstorming sessions.
   - **Market Research:** Conduct research to identify market needs, trends, and competitors.
   - **Concept Development:** Refine the best ideas into detailed concepts, including product features, benefits, and target market.
2. **Feasibility Analysis:**
   - **Technical Feasibility:** Assess the technical viability of the product, considering factors like technology, resources, and expertise.
   - **Economic Feasibility:** Evaluate the financial aspects of the product, including costs, revenue, and profitability.
   - **Market Feasibility:** Determine the potential market size, competition, and customer demand.
3. **Product Design and Development:**
   - **Design Specifications:** Create detailed specifications for the product, including its features, functionality, and appearance.

- **Prototyping:** Develop prototypes to test the product's functionality, usability, and aesthetics.
- **Engineering and Manufacturing:** Work with engineers and manufacturers to bring the product to life.

4. **Testing and Quality Assurance:**
    - **Testing:** Conduct rigorous testing to ensure the product meets quality standards and performs as expected.
    - **Quality Assurance:** Implement quality control measures to maintain product quality throughout the development process.
5. **Marketing and Launch:**
    - **Marketing Strategy:** Develop a comprehensive marketing plan to promote the product and reach the target market.
    - **Launch Plan:** Create a detailed plan for launching the product, including distribution channels, pricing, and sales efforts.
6. **Post-Launch Evaluation and Improvement:**
    - **Monitor Performance:** Track sales, customer feedback, and market trends.
    - **Adjustments:** If necessary, make changes to the product or marketing strategy to improve performance

Essential Tools and Techniques

- **Market Research:** Surveys, focus groups, interviews, and data analysis.
- **Design Thinking:** A human-centered approach to problem-solving that emphasizes empathy, ideation, and prototyping.
- **Agile Development:** An iterative and incremental approach that allows for flexibility and rapid development.
- **Lean Startup Methodology:** A framework for building and launching startups based on customer feedback and validation.
- **Project Management Tools:** Software like Asana, Trello, and Jira to track progress, manage tasks, and collaborate with teams.



Real Product vs. Virtual Product Development

Feature	Real Product Development	Virtual Product Development
Nature	Physical/Tangible (e.g., a smartphone, a car)	Digital/Intangible (e.g., software, apps, websites)
Design Process	Requires **manufacturing, material sourcing, and prototyping**	Focuses on **coding, UI/UX design, and software testing**
Development Tools	CAD software, 3D printing, machining tools	Programming languages, cloud computing, digital simulation tools
Testing	Physical testing (e.g., durability tests, stress tests)	Digital testing (e.g., user testing, debugging)
Production & Deployment	Involves **factories, supply chains, and logistics**	Deployed **instantly over the internet**
Cost	Higher **due to materials and production costs**	Lower **as it requires digital infrastructure only**
Modification & Updates	Expensive and time-consuming	Easily **updated with patches and new versions**

Product Development Process

🔷 The product development process follows structured phases to ensure a successful launch.

Step 1: Identifying the Problem (Empathize & Define)

- ✓ Gather user needs and pain points.
- ✓ Use tools like Persona, Empathy Mapping, and Customer Journey Mapping.
- ✓ Example: Engineering students find online classes disengaging and lack interactive features.

Step 2: Ideation & Concept Development

- ✓ Conduct brainstorming sessions to generate multiple solutions.
- ✓ Use "How Might We" statements to frame the problem creatively.
- ✓ Select the most feasible idea for further development.

Step 3: Prototyping

- ✓ Develop a basic version of the product to test feasibility.
- ✓ For real products → Use 3D models, CAD software, or rough sketches.
- ✓ For virtual products → Build wireframes, mock-ups, or minimum viable software (MVP).
- ✓ Example: Prototype a gamified online classroom platform with AI-driven recommendations.

Step 4: Testing & Refinement

- ✓ Conduct user testing with small groups.
- ✓ Collect feedback and refine the product.
- ✓ Identify any usability issues before full-scale production.
- ✓ Example: Engineering students test the online platform and suggest adding real-time interactive quizzes.

Step 5: Final Development & Launch

- ✓ Develop the final version of the product.
- ✓ Plan the go-to-market strategy (advertising, pricing, deployment).
- ✓ Example: Launch the online learning platform across universities and promote it through student networks.

Step 6: Post-Launch Monitoring & Improvement

- ✓ Gather continuous feedback from users.
- ✓ Roll out updates and improvements based on analytics.
- ✓ Example: Regularly update the platform with new interactive features and AI improvements.

Journey from Problem to Solution for Online Class Product Development

Step 1: Identifying the Problem (Empathy & Define)

🔷 **Pain Points Identified from Persona, Empathy Map & Customer Journey Map:**

✓ **Lack of interaction** – Online lectures feel passive.
✓ **Distraction issues** – Students lose focus easily.
✓ **Lack of hands-on learning** – Difficult to engage in lab-based activities.
✓ **Delayed feedback** – No real-time assessment and feedback.

Step 2: Ideation Phase (Generating Solutions)

🔷 **HMW (How Might We) Statements:**

✓ **How might we make online learning more interactive and engaging for students?**
✓ **How might we provide real-time feedback and assessments in virtual classrooms?**

🔷 **Brainstormed Solutions:**

1. **Gamification features** – Points, badges, leaderboards.
2. **AI-driven personalized learning** – Adaptive content recommendations.
3. **Virtual Labs** – Simulated experiments.
4. **Live Q&A with real-time polls and quizzes.**
5. **Peer-to-peer collaborative projects & discussions.**

Step 3: Prototyping Phase

🔷 **Developed a low-fidelity prototype** – Wireframe of the virtual classroom platform.

🔷 **Features included:**

✓ AI-driven **personalized dashboard**.
✓ **Live interactive polls and quizzes**.
✓ **Virtual lab simulations** for hands-on learning.

Step 4: Testing & Feedback

🔷 Conducted **usability testing** with students.

🔷 Feedback:

✓ Students liked **interactive quizzes** but wanted **more video-based content**.

✓ **Virtual labs** needed better physics simulations.

Step 5: Final Product Development & Launch

🔷 Incorporated feedback, improved **UI/UX design**, and launched **Engage Learn**.

🔷 Promoted through **university partnerships and social media campaigns**.

Step 6: Post-Launch Monitoring & Updates

✓ Collected analytics on **student engagement & retention rates**.

✓ Updated AI algorithms for **better content recommendations**.

✓ Introduced **collaborative group projects for better peer learning**.

Conclusion

🔷 Product development is an iterative process that ensures solutions are tailored to user needs.

🔷 Real and virtual products differ in their development approach but share similar testing and refinement stages.

🔷 Using tools like personas, empathy maps, and customer journey maps, developers can create high-impact solutions.

🔷 For engineering students' online learning, the developed solution enhanced engagement, interactivity, and personalized learning experiences

Challenges and Considerations

- **Uncertainty:** The product development process can be unpredictable, and there is always a risk of failure.
- **Competition:** Intense competition can make it difficult to differentiate your product and gain market share.
- **Changing Market Dynamics:** Market trends and customer preferences can change rapidly, requiring flexibility and adaptability.
- **Resource Constraints:** Limited budget, time, and personnel can pose challenges to product development.