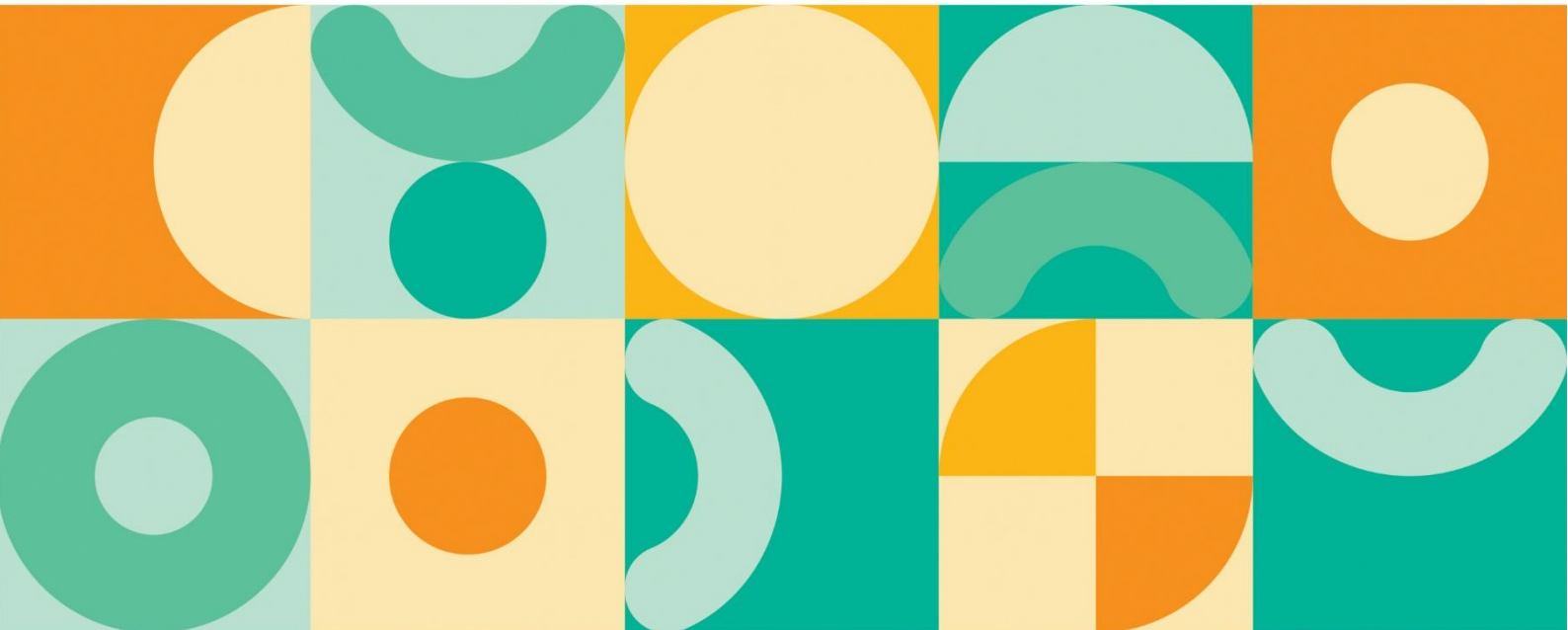
STRENGTHENING STUDENT
ENGAGEMENT IN LEARNING THROUGH

# FACILITATION ADVANCEMENT BOOTCAMP (FAB)

Faculty Handbook



# PRE- SESSION OVERVIEW

# FAB: Vision, Goals and Strategies

### a. What competencies do our students need in the 21st Century?

The world today is changing at a rapid rate with the emergence of new technologies, global connections, and shifting social and environmental priorities. There is growth in areas like renewable energy, health and wellbeing, digital innovation, and social entrepreneurship offering new employment opportunities. As a result, individuals are taking up freelance, entrepreneurial, or project-based work. They are reaching global customers online, working in teams across time zones. Work is becoming more flexible, interdisciplinary, and technology driven.

These evolving environments show that mastering a single skill is no longer sufficient and it is important to develop competencies such as the ability to continuously learn, unlearn and relearn, to adapt to change, work well with others, and apply knowledge in diverse contexts. Thus, students today require education that integrates academic knowledge with thinking, emotions, values, and a sense of responsibility. Together, these interrelated competencies prepare learners not just for employment, but for navigating life with awareness and adaptability in a complex and ever-changing world.

If we look at history, the idea of such education was strongly highlighted in Learning: The Treasure Within, a landmark report by UNESCO (1996) that articulated the four key pillars of learning: learning to know, learning to do, learning to live together, and learning to be. This framework continues to shape global education discourse today, reiterating how education needs to encompass knowledge along with skills, values, and a sense of self.

Building on this idea, Tony Wagner and the Change Leadership Group (2010) highlighted the growing importance of innovation, problem-solving, and adaptability in modern knowledge economies. Their work reiterates supplementing academic knowledge with the capacity to apply learning creatively and responsively. Similarly, organizations like Asia-Pacific Economic Cooperation (APEC) highlight the importance of employability skills and lifelong learning as central to sustainable economic and social development across its member economies. The Organization for Economic Co-operation and Development (OECD) promotes global competencies that support equity, inclusion, and quality learning in an increasingly complex and interconnected world.

**The 4Cs:** Critical thinking, Communication, Collaboration, and Creativity are core competencies in education and work (The Partnership for 21st Century Skills (P21). These 21st-century skills encompass the abilities and attributes that can be intentionally taught and learned to enhance ways of thinking, learning, working, and living in the world (UNESCO-UNEVOC). They are the capacities to use knowledge, skills, attitudes, and values reflectively and responsibly in varied contexts (OECD).

- **Critical Thinking** is the ability to analyze and evaluate information, reasoning, and arguments to make well-informed judgments and decisions (OECD, 2018).
- **Communication** is the ability to clearly and effectively express ideas, questions, thoughts, and solutions through a variety of media and in different contexts, and to listen, understand, and respond to others (OECD, 2018).
- **Collaboration** is the skill of working effectively and respectfully with others toward a shared goal, leveraging diverse talents, perspectives, and expertise, including across networks and digital spaces (UNESCO).
- **Creativity** is the capacity to generate new ideas, think in novel ways, combine existing concepts into fresh solutions, and adapt to changing environments (OECD, 2018).

The National Education Policy (2020) embeds the development of the 4 Cs: Critical Thinking, Communication, Collaboration, and Creativity across multiple sections (4.4, 4.5, 6.8, 11.8), emphasizing a shift from rote learning to competency-driven, skill-based, and experiential education. The National Curriculum Framework 2023 reimagines faculty not as instructors, but as facilitators of inquiry, and mentors who nurture resilience and collaboration, and designers of engaging learning experiences.

Together, these global perspectives converge on a shared message: education must move beyond content mastery to nurture adaptable, reflective, and socially responsible individuals. In this context, the *4 Cs or Critical Thinking, Communication, Collaboration, and Creativity* emerge as essential learning goals for students in today's world. They help learners to learn and to be a part of the evolving 'world of work' with confidence and purpose.

### b. How can we support students in realizing their priorities?

Fostering the 4 Cs in students requires a range of instructional approaches in the classroom. David A. Kolb (1984) emphasized that learning is a dynamic process in which knowledge is created through the transformation of experience. He proposed four interconnected stages of the teaching–learning process:

- Concrete Experience: In this process, students "do or have experience". E.g. a lecture or PowerPoint presentation with reflective prompts, a group task, a reading comprehension exercise, or an experiment. Collaboration and Communication come alive as participants interact, share perspectives, and engage together to accomplish a goal.
- Reflective Observation: In this process, students "review and reflect" by pausing to think about their experience through guided reflections or key takeaways. There is Collaboration as learners share experiences and listen to diverse viewpoints; and Critical Thinking when they question assumptions, identify patterns, and connect learning to life.
- Abstract Conceptualization: In this process, students "conclude the experience" through facilitator wrap up sessions or by probing concepts deeply and relating to theory. Communication and Creativity emerges as they generate new ideas or articulate their imagination as to how classroom scenarios might unfold differently in varied life contexts.
- Active Experimentation: In this process, students "plan and try out what they have learned". They apply their understanding by designing a project or using learned strategies to solve problems. There is Critical Thinking and Creativity as learners test, adapt, and refine their approaches based on feedback.

Fostering the 4 Cs also requires planning student-learning involving their multiple dimensions of being. This includes:

- Thinking critically, analyzing, questioning, and generating ideas (cognitive dimension)
- Observing and interpreting experiences, including through the senses (perceptual dimension)
- Interacting, learning with and from others, practicing shared values (social dimension)
- Moving, drawing, coordinating, and engaging the body in learning (psychomotor dimension)
- Applying learning, taking responsibility, and practicing skills in real contexts (behavioral dimension)

These dimensions are deeply interconnected and continuously influence one another. Learning and understanding are deep when these dimensions are aligned. E.g. *in group work, students think, express emotions, interact with others, and engage physically.*

### c. What does FAB contribute to students' priorities?

FAB, a 3-to-5-day workshop, enables participants to experience, practice, and reflect on a range of student engagement approaches. Through facilitator-led wrap ups, they engage with the underlying theory behind each strategy, strengthening both understanding and their application.

Participants also deepen their self-awareness by reflecting on their experiences, values, and beliefs about teaching–learning, while developing a broader perspective on the contexts that shape students' lives. Guided by reflective prompts, they articulate shifts they are considering in their own practice and outline how they might implement their learning. Additionally, each participant identifies a question to explore further, extending their learning beyond the workshop.

All sessions model an environment grounded in attentive listening and opportunities for participants to express their thoughts, feelings, and concerns. Open dialogue is woven throughout, whether in small-group work or during key takeaways, ensuring that everyone participates and contributes to each other's learning.

In this respect, FAB encourages teachers to include such interactions in their daily routines. This calls for them to observe closely, reflect continuously on students' learning and behavior, and co-create classroom norms and expectations along with students. Equally important is that teachers have informal conversations with students as to how they are thinking and feeling about themselves; and how they are making efforts in learning and in their relationships.

As Artificial Intelligence continues to reshape industries worldwide, a classroom presents an opportunity to implement transformative learning experiences. In FAB sessions, participants use AI to design learning plans by drawing on strategies experienced during the sessions as well as those they already use in their classrooms. Thus, they reaffirm and value the rich experience each teacher brings.

## FAB Sessions

- FAB Session 1: Framing the Learning Journey

Building on the welcome and introductions, the first session orients participants to the purpose and intent of FAB. Through guided prompts and a large-group discussion (on the reading *'Responding to Youth Unemployment')* participants engage with a complex issue affecting students and examine the interconnected roles of diverse stakeholders in strengthening school-to-work transitions. They share observations, listen to varied perspectives, and build on one another's thinking.

Participants also revisit and make connections to the four engagement strategies experienced during the session: Building Purpose in Learning, PPT with Prompts, Writing Before Speaking, and Reflecting on Feelings and Beliefs. In the recap, reflection, and takeaway segment, they synthesize key insights, surface their emotions, critically reflect their implicit beliefs and existing practices, and identify meaningful shifts in the way they see their teaching-learning.

- FAB Session 2: Learning through the Journey

Through group work, participants explore and develop different categories of questions. They reflect on how these can be purposefully used in their classroom practice. They revisit four key engagement strategies that leverage questioning: During Context Setting, to Deepen Learning, to Guide Small-Group Discussions, and to Assess Learning. They also reflect on how to encourage students to ask their own questions.

Participants engage in concept mapping to explore a topic in depth, strengthen conceptual understanding, and connect across ideas. This is followed by large group sharing, where they learn from one another. They engage in peer feedback and build self-awareness. They reflect on the range of engagement strategies they experienced: Concept Mapping, Small-Group work, Large-group sharing, Consolidation of learning, and Peer Feedback and consider how these can be applied in their own teaching-learning.

- FAB Session 3: Embracing the Learning Journey

Participants identify the 4 Cs both as reflected in their students' current behaviors and as priorities they wish to nurture in them. Guided by carefully structured prompts and selection of appropriate engagement strategies, they design a Learning Plan emphasizing students' needs and unique contexts. After this they engage in Gallery Walk, observing and appreciating the diversity of approaches.

They revisit two key engagement strategies: Leveraging AI and adopting flexible approaches to learning plans. They reflect both the possibilities and the boundaries of AI and ground their decisions on the core purpose of education. They emphasize that meaningful and sustainable change emerges not from perfect documentation / perfect learning plans, but from small, consistent shifts in everyday practice.

The session concludes with participants affirming one another's efforts in the workshop. They synthesize key insights and identify specific strategies they intend to implement. Each participant writes in their handbook one teaching practice they intentionally commit to implementing within the next three weeks.

- FAB Session 4: Living the Learning Journey

Participants work collaboratively in small groups to plan and facilitate a lesson that integrates student engagement strategies. They draw on strategies explored during the program, along with a few additional approaches such as experiments, project work, demonstrations, reading, and practice tasks. To understand these strategies, they explore curated videos and brief reading materials.

Throughout the activity, participants share responsibilities, make decisions, and work together towards a common goal. Each group facilitates a lesson for peers and has an opportunity to practice learner-centered teaching.

Following the lesson facilitation, participants engage in a debrief using guided reflection prompts. Together, they examine the effectiveness of the strategies used, discuss their strengths and challenges, and reflect on how these approaches can be meaningfully adapted in classrooms.

This collaborative experience enables faculty to learn from one another, exchange ideas, and strengthen a community of practitioners. The session concludes with a discussion on: Facilitation of Learning and Professional Learning Communities. At the end each participant once again commits a practice within the next two weeks.

*The overall structure of FAB as per the experiential learning is as follows:*

Pre-session and Sessions 1–2: Experiencing, Reflecting and Connecting

- Participants engage in a range of experiences that they can take back to their classrooms not by replicating them *as is*, but by contextualizing and adapting them to their own learners and contexts.
- Participants reflect on the experiences they have had during the workshop and relate them to themselves, their teaching practice and their context.
- Participants connect their experiences to the theory and ideas underlying them. They move from the person to the universal, making connections and generalizing their learning.

Sessions 3–4: Designing, Trying Out and Applying

- Participants plan and try out how they can apply what they have learned through design, practice and peer learning. They translate their learning into concrete possibilities for their own classrooms.

# Gratitude

We gratefully acknowledge the unwavering support of the Directorate of Technical Education, Uttar Pradesh, and Haryana in conceptualizing and guiding this initiative. We are thankful to the Principals and Faculty Members of the Polytechnics of these states for their sustained commitment to implementing and strengthening the Facilitation Advancement Bootcamp (FAB) year after year since its inception in 2021.

We thank Mr. Byomkesh Mishra and Mr. Christopher Turillo, the Co-Founders of Medha, for their clear and compelling vision that continues to guide and inspire our work. We acknowledge Saurabh Rai (Vice President, Medha) for providing strategic direction in initiating the revision process of FAB in 2026.

We extend our heartfelt appreciation to Preety Thapa (AVP, Medha) and Richa Sinha (Senior Manager, Medha) for laying the foundation of the Facilitation Advancement Bootcamp in 2021 and Priya Iyer (Lead, Curriculum Design, Medha) in supporting key revisions in 2026. These refinements draw upon the continuous field insights of program implementation teams: Uttar Pradesh and Haryana. We deeply appreciate Jai Tiwari (VP, MarCom, Medha), Mohd. Nadeem Siddiqui (Brand Lead) for coordinating the handbook, and Mrs. Anjali for designing it as a vibrant and engaging learning resource for every workshop participant.

Sincerely,
Curriculum Design Team

# Welcome

Let us gently close our eyes.
Pause in silence for a few moments.
Listen to the music in the background.

**Recall a person who has positively contributed to shape your life journey.**

- Who came to you? What did they do that truly made a difference in your life?
- Was it something they said, something they believed about you, or simply the way they showed up?
- Gently open your eyes and share: Who did you think of; and what quality or action are you most grateful for?

As we listen to one another, notice the qualities that surface repeatedly: patience, encouragement, trust, belief, guidance, empathy, consistency, etc.

These qualities matter to us because they influence us deeply. And perhaps something even more powerful is true: *'The qualities we recognize and appreciate are often the very qualities we carry within ourselves'.*

Our teachers, in many ways, embody this truth. They influence our life journeys. "Teachers truly enrich the lives of our students and, therefore, shape the future of our nation" (National Education Policy 2020). Indeed, the impact of teachers extends well beyond classrooms, shaping lives and possibilities.

The Facilitation Advancement Boot Camp (FAB) carries this idea forward by building a community of educators committed to student growth. It recognizes teachers as reflective professionals who facilitate deep, meaningful learning experiences to strengthen academic understanding and orient students towards lifelong learning and responsible living.

We honor the depth, dedication, and dignity of the work of teachers and are delighted to have them as collaborators in this journey of learning and facilitation. Together, in this workshop we shall ask questions, share experiences, reflect, explore and create ways to make teaching-learning more inclusive and purposeful for our students.

## Walking Together and Introductions

- Participants, please spread across the room. As the music plays, move around the room. Let us all do three different walks:
    - First, walk in silence, without talking or making any eye contact. Just be in your own world. Once the music stops, pause exactly where you are.
    - Continue walking and in this second walk do not speak but greet one another with your gestures such as smiles, a handshake, namaste, salaam or simply nod. When the music stops, pause where you are.
    - In the last walk, try meeting as many people as you can, introduce yourself, and know a unique thing about each other. Share one quality or aspect of yourself that you appreciate and feel happy about.

- When the music stops, return to your place. Share your reflections on the three walks:
    - How did you feel during your first walk?
    - How did you feel to pause and be with yourself on the second walk?
    - What was your experience on the third walk?

Hope we have met a few new people and got to know them through this activity. Over the next few days, let's continue to connect with one another not just during the sessions, but also informally over tea breaks, meals, and conversations. Each person brings unique experiences and perspectives, and getting to know one another will enrich our learning journey together.

## Attendance and Stationery

*Participants, thank you for your engaging introduction.*

Please collect your stationery kit. It includes the FAB Faculty Handbook, a key resource to plan our learning, to reflect on experiences, document insights, and actively engage with one another. In the Handbook, each sub-session is marked with a star symbol and a guiding phrase that indicates the nature of participation expected.

Please use the handbook actively, make notes, jot down reflections, and capture your key learnings as you engage with a discussion.

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# FAB SESSION 1:

# FRAMING THE LEARNING JOURNEY

# 1.1 FAB: An Introduction

*Participants, let us engage with the PPT presentation that is based on the reading material 'Responding to Youth Unemployment". Before each slide, you will see a prompt/question. Reflect on the prompts, share your observations and questions, and contribute to each other's understanding.*

**Reading Material: Responding to Youth Unemployment**

a. The Youth Unemployment Challenge: A Global and National Reality

Globally, 267 million young people aged 15–24 are not in employment (UNESCO, 2022). In India, the overall unemployment rate stands at 4.7%, with rural rates lower than urban ones (PLFS, 2025). However, youth unemployment in urban areas rises sharply to 15.8%, nearly three times the national average. Among graduates, unemployment ranges between 18% and 29% (PLFS, 2022–23), revealing that even higher education does not guarantee employability. At the national level, nearly one-third of youth aged 15–29 is not in employment, education, or training, indicating structural challenges in youth transitions. Lack of meaningful youth participation in the workforce is a global challenge.

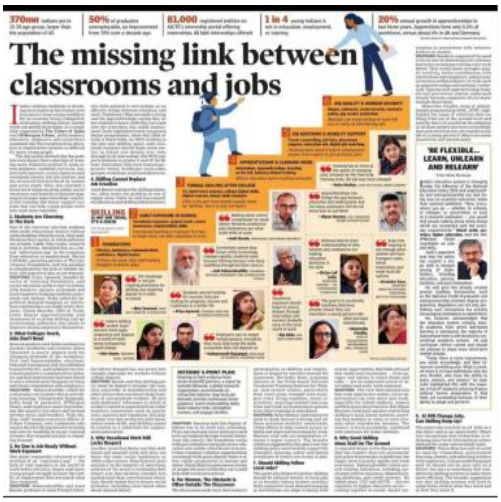
At the same time, India possesses one of the largest youth populations in the world, offering immense demographic potential. Yet labor force participation among young people remains uneven. In Uttar Pradesh, only 17–18% of young women aged 15–29 participate in the labor force (MoSPI, 2023–24). In Haryana, many young people exiting school experience difficulties in securing stable employment.

b. What are some causes of this situation of unemployment?

National data indicate that 15.4% of students drop out after Grade X and 17.1% after Grade XII (UDISE, 2021–22). In Uttar Pradesh, the secondary-level dropout rate is 8.7% (UDISE, 2023–24), while in Haryana it is 3.8% (Ministry of Education, 2024). Financial pressures further intensify these trends. According to NFHS-5 (2019–21), 16% of boys and 20% of girls cite financial constraints as a major reason for leaving school, while 37% of rural girls discontinue education to support their families. *These are structural gaps that need our serious attention.*

Beyond 'access and affordability', *systemic gaps persist within the education system.* There is often limited continuity between curricula, learner expectations, and skill requirements across stages of education and employment. Many students transition from one level to another without adequate academic foundations, socio-emotional readiness or career guidance, and counseling. Learning gaps and disengagement in learning contribute to poor preparedness of the youth for the demands of an evolving economy.

(Source: The Times of India, March 21. 2026)


The missing link between classrooms and jobs

As we look at the situation closely, we see that the issue is not only unemployment, but also the quality and stability of employment available to youth. While the economy is reshaped by technological change, evolving labor market demands, and global uncertainty, the education system in India continues to be largely theoretical and exam focused. This has led to a widening gap between education and employment, with both employers and young job seekers struggling to align expectations. Hiring is increasingly driven by demonstrated skills, such as adaptability, problem-solving, and digital competence, rather than degrees alone. At the same time, limited integration of institutions with industry leaves many students without adequate exposure to application of learning in life.

### c. What is the impact of unemployment on Youth? Who is affected the most and how?

The impact of systemic and structural gaps is not evenly distributed. Girls and young women, particularly from rural and disadvantaged backgrounds, face greater barriers to participation in education and employment. First-generation learners and youth from economically vulnerable households are also disproportionately affected. Graduates without employable skills encounter frustration and uncertainty, further deepening inequalities.

The mismatch between education and employability forces many young people into informal, temporary, or low-quality jobs (India Employment Report, 2024). Beyond economic instability, unemployment carries significant social and psychological consequences. Young people may experience confusion, disengagement, or loss of self-worth. Mental health challenges linked to unemployment are rising globally (WHO, 2023). Prolonged youth unemployment can contribute to social unrest and weakened social cohesion. Critical transition points of life such as completion of secondary school or graduation become moments of vulnerability rather than opportunity.

It is important to reflect that India's youth unemployment crisis is not a question of job scarcity, but gaps in preparedness, alignment, and meaningful transitions from education to work.

India's large youth population must be recognized as a national asset rather than a burden. Harnessing this demographic dividend requires a focused effort to strengthen learning, school-to-work transitions, and enhance employability. Education must prepare young people not only for academic success, but also for a dynamic and evolving economy and life.

### d. How can India unlock the full potential of its youth?

Bridging the gap between education and employment requires structured pathways and an integrated approach in which learning and work occur simultaneously ensuring individuals are educated and employable in a rapidly evolving economy. This calls for following actions:

- Strengthening foundational skills, including literacy, numeracy, the 4 Cs and digital fluency
- Providing early exposure in schools through vocational awareness, project-based learning, career exploration and counselling
- Introducing formal skilling pathways after school and college, including ITIs and short-term training programs
- Expanding work-based learning opportunities such as apprenticeships, internships, and on-the-job experiences
- Offering job matching and mobility support, job fairs, and relocation assistance
- Ensuring job quality and worker security for sustainable employment

### e. Can this be achieved by individuals alone?

Such transformation cannot be achieved by any single actor alone. It depends on sustained partnerships among institutions, educators, parents, industry, and policymakers: each contributing through incremental yet meaningful steps. This journey begins with a shared commitment and the courage to take the first step. The steps need to be small, but intentional, consistent, and cumulative, each one building momentum and leading to meaningful, lasting change.

- Medha and Government Partnership

In this context, *Polytechnics* across the country play a crucial role in strengthening technical competencies and enhancing employability among young people. As institutions designed to bridge education and industry, they offer practical pathways for students seeking skill-based careers and applied learning opportunities. Students have a wide range of diploma courses and a variety of trades or opportunities to choose from. There are continuous efforts to cater to varied learner interests and regional economic needs and to equip learners with both practical skills and theoretical foundation. Thus, preparing them for industrial employment, entrepreneurship, or higher education.

While course offerings and infrastructure have expanded, the real challenge lies in ensuring effective transitions from training to meaningful employment. The issue is not only access to technical education, but also the quality of learning, alignment with industry expectations, and the development of essential competencies required for the 21st century world.

- Similarly, Medha prepares young people for life beyond school through future-ready skills, career preparedness, and sustained alumni support. Its approach goes beyond academic competence to emphasize hands-on technical skills and work-based learning opportunities. By partnering with state governments, educational institutions, and employers, Medha enhances workplace readiness of the youth and facilitates access to employment opportunities. Such coordinated engagement is critical; as UNESCO notes, effective alignment between education systems and labor markets enables smoother transitions from school-to-work.

Since 2019, Medha has been collaborating with the Directorate of Technical Education in strengthening Industry–academia relationships, increasing access to work-based learning, organizing placement drives, facilitating industrial training, and enabling on-the-job learning experiences. There are efforts to strengthen infrastructure, curriculum, teaching-learning, and outcome-based education across Government colleges.

**f. What can be our role as educators to bridge the gap? What can be our small and meaningful steps?**

Set against the backdrop of ongoing efforts to enhance learning and employability outcomes in Government Polytechnic institutions, the Facilitation Advancement Boot Camp (FAB) aims at fostering student-centered learning experiences for enhanced understanding and meaningful real-life application. With this intent, the objectives of FAB are to enable faculty-

*"To strengthen 'student engagement' in learning by adopting diverse experiential teaching–learning practices that foster the 4 Cs: Critical Thinking, Collaboration, Communication, and Creativity among students"*

Classrooms that intentionally cultivate 21st-century skills enhance student engagement and enable learners to connect academic knowledge with real-life contexts.

Student engagement is a continuous process that requires the integration of multiple approaches and incremental shifts in teaching-learning practice. This calls for educators to continue what already works, besides enriching their teaching by incorporating a range of strategies. Meaningful and sustained student engagement emerges not from a complete overhaul, but from consistent, intentional small changes. These "small steps" are powerful because they are practical, sustainable, and adaptable across diverse classrooms contexts.

*Let us come together to take these steps forward towards student engagement!*

## 1.2 Reflections

*Participants: Think about the sessions so far (welcome, introductions, PPT presentations). Use the following two prompts to write your key reflections. After writing, share your reflections in the large group.*

1. Pause and gently check in with yourself: How am I feeling right now? What emotions are emerging in me at the moment?

2. We all have our own beliefs about teaching and learning. E.g., some of us prefer starting with experiments and then moving to theory, while others do the opposite.
   Take a moment to reflect and share: **What are my current beliefs about teaching and learning? Based on these beliefs, what is one change I am now considering making in my teaching practice?**

## 1.3 Facilitator Wrap-up: Strengthening the Foundations

*Participants: Here are some engagement strategies that we experienced a while ago. Please take a few moments to read them silently and summarize them in your own words. After that, I may also add a summary, if needed, and connect ideas.*

Learning does not begin with activities but with strong foundations. This happens when teaching-learning embeds the thinking, purpose, and structure that supports them. Without these, teaching is an isolated task. Activities may evoke interest but sometimes are disconnected from deeper understanding.

a. Building Purpose in Learning (Engagement Strategy 1)

When we intentionally connect learning to a larger purpose and meaningful context (such as youth unemployment), we strengthen the base on which deep and meaningful engagement is built. *Before students begin a unit, long-term projects, or an emerging school-level task such as organizing an exhibition*, it is important that they connect these tasks with a broad purpose. This requires teachers to create a shared understanding with students by simply talking about what they will be working on, why it matters, and how each student contributes. This helps gain clarity for purpose and expectations. This, in turn, leads to more thoughtful, confident, and meaningful participation by students.

b. A PPT with Prompts (Engagement Strategy 2)

A PPT or a lecture with prompts interspersed throughout enables students to participate in the learning process such as thinking, processing ideas, making connections with others' ideas, responding, asking questions, and reflecting. *Teachers may use case studies, videos, reading materials, and even lectures with thoughtful prompts to engage* students more deeply with the content and facilitate effective communication across the class.

c. Writing before Speaking (Engagement Strategy 3)

Before expecting students to share their responses, it is important to give them time to pause and write down their thoughts. Learning becomes deeper when students get time to think, organize their ideas, and make sense of what they have learned on their own. *Writing helps bring clarity and builds a sense of ownership.*

When students think first and speak next, discussions become richer, more balanced, and meaningful. Connecting their own experiences and insights turns activities into real understanding. Writing before speaking also supports every learner, especially those who may hesitate to speak. Writing gives them time and confidence to process their ideas and express themselves more clearly.

d. Reflecting on Feelings and Beliefs (Engagement Strategy 4)

We all carry certain beliefs about student learning and intelligence. *E.g., some may believe that intelligence is fixed, while others believe that learning grows through effort, exploration, and experience.* These beliefs shape what we expect from students and how we teach: project-based learning or note-making and dictation. Similarly, our feelings and emotions also influence our actions in the classroom. E.g. a*t times, we may feel anxious, frustrated, empathetic, or compassionate.* These emotions guide how we respond to students: either with patience and care, or in a more reactive way.

A teacher's beliefs and feelings impact student motivation and engagement in learning. *E.g. when teachers believe that students can grow and improve, students feel encouraged*. They are more likely to build confidence, take initiative, and keep trying. Thus, students are very sensitive to their teachers' attitudes, and this shapes how they see themselves as learners.

It is important to recognize that our feelings are natural. Instead of ignoring them, we can reflect on them. E.g. We can ask ourselves: *What is giving me energy? What might be holding me back?* Such reflection helps build self-awareness and guides our practice. Over time, it helps us question our beliefs and consider required shifts in them.

- Student Reflections

Besides their own reflections, teachers need to create space for students to reflect on their thoughts, feelings, and beliefs. This is essential for their self-awareness and deep learning. Teachers may do this at the end of each chapter using one or two simple prompts. E.g. They may ask students, *"How did you feel about the group work?"* or "What did you learn from testing your hypothesis?"

After a lesson, teachers may encourage students to explore their thinking further by asking, "What makes you think that?" or "What did you notice about yourself?" It is important to help students see reflections as a process of discovery and not a task with a predetermined answer. It is not about a right or wrong answer; but about making sense of their own experiences, thoughts, feelings, and learning. Teachers can model by sharing their own reflections and showing how people may experience the same situation differently.

## 1.4 Session One Recap and Takeaways

Participants, thank you for your participation in FAB sessions so far. As we meet tomorrow, let us come prepared with a task. Here are some guidelines for it:

**First**: please review your notes from Session 1, reflect on your experiences, and identify one key takeaway that you would like to remember and carry forward.
Note down these observations here and share them with all tomorrow.

**Second**: please visit the 4 Cs table below. In column B, place a ✓ against the aspects of the 4 Cs that you have experienced during session 1 or you were already aware of prior to it.

| The 4 Cs | | | |
|---|---|---|---|
| Often summarized as the 4 Cs, the 21st-century Skills foster active and meaningful engagement in learning. By intentionally integrating the 4 Cs into our teaching-learning practice, we can create learner-centered classrooms that prepare learners for academic success as well as for higher education, careers, and lifelong learning. All skills and competencies are interrelated and transferable across diverse contexts. This means that what learners develop in one setting (such as the classroom) can be effectively applied in other situations, including real-world challenges, different subjects, workplaces, and social interactions. Similarly, these skills are not limited to a single task or discipline; instead, they enable learners to adapt, problem-solve, collaborate, and communicate in varied and evolving environments. | | | |
| A | B | C | D |
| The 4 Cs | I am aware of (✓) | Our students demonstrate in daily life (✓) | I prioritize this for my students' learning (✓) |
| **Critical Thinking**<br>• Analysis of ideas and situations; relating them to life<br>• Identification of causal relationships between concepts<br>• Stating linear progressions and patterns in concepts<br>• Comprehension of a text, interpretation in own words<br>• Arriving at a decision by giving logical reasons<br>• Stating real-life application of key concepts | | | |

| | | | |
|---|---|---|---|
| Creativity<br><br>• Generating new ideas<br>• Using learning to solving problems<br>• Designing a range of questions<br>• Drafting prompts to deepen learning<br>• Drafting prompts to develop self-awareness | | | |
| Communication<br><br>• Consolidating ideas by writing before speaking<br>• Expressing ideas clearly and coherently<br>• Offering viewpoints<br>• Asking meaningful questions<br>• Asking clarificatory questions<br>• Listening to understand<br>• Explaining and refining ideas through dialogue<br>• Organizing information, presenting in large group<br>• Share own thoughts and feelings | | | |
| Collaboration<br>• Working in small groups and completing tasks<br>• Discussing and building on others' ideas<br>• Listening to varied perspectives and experiences<br>• Appreciating and valuing group processes<br>• Actively engaging with people<br>• Giving and receiving feedback<br>• Questioning beliefs and assumptions | | | |

**Third:** We request two members to prepare a brief recap and reflection on today's session and share it during tomorrow's meeting. We will begin tomorrow's session with this activity.

# SESSION 2 :

# LEARNING THROUGH THE JOURNEY

## 2.1 Crafting Questions

*Participants - Divide yourselves into small groups such that each group has 6 members. Use the following guidelines to do your work.*

**First**: Discuss the following 6 categories of questions by relating them with them examples as given in column A of the table:

- **Category 1:** Learners recall or recognize relevant knowledge. E.g., they share a fact, define a concept in their own words, list steps of solving a problem, or identify a problem.
- **Category 2:** Learners share understanding by interpreting information presented in oral, written, or visual form. E.g., they summarize a chapter, explain the situation after watching a video, interpret a graph, or describe a poster or a diagram.
- **Category 3:** Learners apply knowledge in new situations or contexts of life. E.g. they plan to solve a problem, they solve a problem, or suggest ways to save water or electricity
- **Category 4:** Learners analyze information, identify patterns, and examine relationships among multiple factors. E.g. they compare two situations, tell cause and effect relations in climate change, tell why things worked or did not work, or identify factors that influence a situation.
- **Category 5:** Learners evaluate a situation and arrive at a conclusion. E.g. they tell which option is the most suitable and why, decide a solution to a problem and offer rationale, assess the impact of a situation on something, or review and give recommendations.
- **Category 6:** Learners invent or create something new. Example: they arrive at an idea or construct something.

**Second**: Choose any question from column A, transform that into any other category of questions and record your response in column B. Frame questions such that they are related to life situations: college, family, or local community.

**Third**: Once you have transformed questions, state where you can use it in class: E.g.

- Beginning of the lesson: to initiate learner engagement
- Middle of a lesson: to deepen learner engagement and, to assess learning
- End of the lesson: to support recap, reflections and consolidate learning

**Fourth**: After all groups have completed column B and C of the table; one member of the group will share their response with all other participants. As one group is sharing, please note similarities or differences in between each other's work.

| A: Original Question | B: Transformed Question | C: Use of Questions |
|---|---|---|
| **Category 1:**<br>*Look around your surroundings (inside or outside the classroom). What* are the three states of matter? Identify one substance you see and state which form of matter it is.<br>Or<br>Identify a rotating machine you have seen that shapes metal. Tell its function? | | |
| **Category 2:**<br>A motor engine becomes hot after running for some time, while a lake usually remains cool even on a hot day. Use your own words to describe the underlying reasons.<br>Or<br>Why can't high voltage be used directly in homes? Explain your observations or experiences in your own words. | | |
| **Category 3:**<br>A member of a family works hard throughout the day and feels very tired by evening. In a similar way, a motorbike engine becomes very hot after running for a long time.<br>What similarities do you notice between the two situations? What should the person and the motorbike do to regain energy or to recover and function well again?<br>Or<br>How would you use a transformer to safely supply electricity to a household? | | |

| | | |
|---|---|---|
| **Category 4:**<br>A pressure cooker is used to cook different quantities of rice and water, yet the rice often cooks properly each time. Why does the cooking outcome remain similar even when the quantity changes? What is the science behind this?<br>Or<br>Analyze how changing coil turns affects output voltage | | |
| **Category 5:**<br>Two new engines have been introduced in the market. Engine 1 runs on combustion, while Engine 2 operates without combustion.<br>Which engine would you recommend based on energy efficiency? Justify your choice with reasons.<br>Or<br>Which transformer is best for home use and why? | | |
| **Category 6:**<br>Draw and show a design of an engine that does not use diesel, petrol, or gasoline.<br>Or<br>What alternative source of energy will this engine use, and how will the engine function? Explain your ideas in your own words. | | |

## 2.2 Facilitator Wrap Up: Thoughtful Questioning

*Participants: Here are some engagement strategies that we experienced a while ago. Please take a few moments to read them silently and summarize them in your own words. A few of you may share your summary with all in the session. After that, I may also add a summary, if needed, and connect ideas.*

Questions fall into several categories, and these categories build one another. They often occur together. They serve many purposes and can be meaningfully integrated at different stages of the teaching-learning process:

### Questions / Prompts Across a Lesson (Engagement Strategy 5)

#### a. Questions to Set the Context of Learning

*Context Setting* through questions as an initial step helps teachers to make meaningful connections between students' responses and the topic/ chapter. A question at the beginning of a unit or a chapter sparks curiosity, activates prior knowledge, and prepares learners for the new content. Such questions could be asked verbally or supplemented with a picture or video.

Scan QR Code:

- Before the video, teachers may pose a question like: Have you ever thought why do some tools cut faster and others wear out quickly? After the video, teachers' questions may be like: Why are some materials better for high-speed cutting?

Such questions are the most effective when they are connected to real life situations, both familiar and unfamiliar to students. They do not focus on the right or wrong answers but enable sharing experiences or connecting with examples. Such questions help teachers to gauge students' prior understanding, their lived experiences, assumptions, and potential misconceptions. Further, they are able to structure their lessons at an appropriate pace, and support mechanisms to engage all learners.

#### b. Questions to Deepen Understanding

When teachers ask thoughtful questions during a lesson, whether between a PPT, video, reading, or lecture, students have opportunities to contribute their ideas and engage actively in learning. *E.g. Teachers may ask: Based on the video clip we just watched, what do you think would be the outcomes if the experiment were done under different conditions?*

#### c. Questions to Guide Small Group Discussions

When teachers provide prompts to students for small group discussions (or other project activities), students get directions to exchange ideas, build on each other's thinking, and arrive at deeper understanding collaboratively. *E.g. Teachers may give prompts: Discuss how the concept of energy conservation applies to the machines in the lab. Can you think of ways to make them more efficient? Share your ideas and collate your suggestions.*

d. Questions to Assess Learning

Questions are important tools for assessment. A variety of questions can be designed as formative assessments to gauge students' understanding, track their progress, and refine learning. *E.g. Teachers may give prompts during the class, ask a clarifying question, invite students to ask questions, give examples, or share key takeaways.*

e. Questions to Support Recap and Reflections

When teachers use thoughtful questions during recaps and reflections, they foster self-awareness. Students are able to reflect on their thoughts, feelings, and responses. E.g. *How did this activity make you feel, and why? What challenged you the most? What did you learn about yourself through this task?*

### Students Asking Questions (Engagement Strategy 6)

It is important to encourage students to ask questions because questioning is central to how deep, meaningful learning happens. When students ask questions, they demonstrate deeper engagement and are more likely to persist through challenges and tasks. With prompts, students can be asked to frame questions during a lesson. E.g. Express these through questions: What is one thing you are curious about in today's lesson? Is there something you want to learn more about or explore further? Which part of today's lesson was confusing to you? Was there a concept you didn't fully understand?

It is important to create a safe and supportive environment for students to feel comfortable asking questions. Teachers can foster this by demonstrating vulnerability and acknowledging that they do not have all the answers. They may tell students, "I don't know yet. Let's find out together." Thus, they show that not knowing is not a weakness, but an opportunity for learning. By modelling curiosity, openness, and a willingness to explore, teachers can create a classroom where inquiry is valued, questions are welcomed, and teachers and students learn together.

## 2.3 Concept Mapping and Group Sharing

*Participants, form groups of 5-6 members. Choose any of the three reading materials (or any topic from your course book) and work on a task by using given guidelines.*

First: Each one reads one section of the reading material. After reading, every member of the group will draw a Concept Map of the same section that they have read in the table below. Ensure that the following '4' prompts are used:

**Prompt 1: What is the central idea or the core principle of this reading material?**
**Prompt 2: Which concepts are interconnected? Which factors influence each other?**
**Prompt 3: How does this topic connect to everyday experiences?**
**Prompt 4: What questions emerge from this topic that could be explored in future?**

**Scan QR Code:** Concept Map:

(source: The Learning Center, University of North Carolina at Chapel Hill)

| My Concept Map | |
|---|---|
| Central Idea | Interconnections, Influencing factors |
| Use or Application | Emerging Research Question |

- **Second**: Once the concept map is made, each group member will explain their concept map to other team members.
- **Third**: One member of the group will consolidate all small sub-group concept maps in a chart or flip chart paper and create a consolidated concept map
- **Fourth**: Each group will share their concept map with all participants.

Remember:

- Not to explain, teach the topic or to make a 'presentation'
- The focus needs to be on sharing a summary of the topic in 4 broad headings (as per the format in the table above)

## Reading Material: Thermodynamics

Learning Objectives: After completing the chapter, the participants will be able to:

- Explain the basic scope of engineering thermodynamics and its common areas of application
- Demonstrate an understanding of fundamental concepts of thermodynamics

### a. What is thermodynamics?

When you rub your palms quickly for a few minutes, they start to feel warmer. Your muscles perform work, generating heat; therefore, you feel warmer. Heat and work are two forms of energy. Work can be converted to heat. However, can heat be converted to work? Can we use heat to produce work?

Heat Engine is a device that produces work continuously by absorbing heat from a high-temperature heat source and rejecting the waste heat to a low-temperature heat sink. Since the 17$^{th}$ century, various heat engines were invented in an attempt to harness work from heat. E.g. Watt's engine invented by Scottish engineer James Watt in the late 18$^{th}$ century demonstrates how heat is converted to work. This conversion relies on the phase change of a working fluid, e.g., water, in the Watt's engine. All heat engines need a working fluid circulating in a specially arranged set of equipment, which operates between a high-temperature heat source and a low-temperature heat sink.

A certain amount of heat does not convert to work. It is true that not all the heat from a heat source can be converted to useful work! Heat engines and their underlying principles are governed by the two fundamental laws of thermodynamics. (1) The first law of thermodynamics is energy conservation. Energy can neither be created nor destroyed. It can only be converted between different forms. (2) The second law of thermodynamics explains why all real processes are irreversible, and how the irreversibility of a process is quantified with the concept of entropy generation. All processes always occur in the direction of producing positive entropy generation due to the existence of irreversibility. From the second law of thermodynamics, we can estimate the theoretical limit of efficiency that a real thermodynamic process or system can possibly achieve.

Thermodynamics emerged in the early 19$^{th}$ century with the inventions of heat engines. It originally focused on the scientific theories of heat-work conversion, and the operations and efficiency improvement of heat engines. In engineering fields, the principles of thermodynamics are widely used in the design of thermal systems, such as power plants using different energy sources (e.g., steam, gas, nuclear, hydro, wind, and solar), air conditioning and refrigeration systems, jet engines, biomedical devices, and chemical processes, to name but a few. Nowadays, thermodynamics is used in all fields related to energy conversion and conservation. A nuclear power plant's performance and efficiency are governed by the fundamental principles of thermodynamics.

### b. Systems and Surroundings

In thermodynamics, a system refers to a selected quantity of matter in the case of closed systems or a selected region in space in the case of open systems. The rest of the universe outside the system is called surroundings, and the surface that separates the system and its surroundings is called boundary. A boundary may be fixed or movable, real or imaginary, rigid or flexible. A system interacts with its surroundings through two mechanisms: Mass transfer and Energy transfer (i.e., in the form of heat and work)

A system of a fixed mass is a closed system which can only interact with its surroundings through energy transfer. Mass cannot cross the boundary of a closed system. For example, a sealed bottle of soft drink can be modelled as a closed system because there is a fixed amount of liquid in the bottle. When you take the bottle out of your cooler, the liquid will warm up slowly due to the temperature difference between the bottle and the ambient air (surroundings). In other words, the system (the liquid in the bottle) interacts with its surroundings (the ambient air) through energy transfer (in the form of heat transfer).

An open system also called control volume is a selected region in space. An open system always exchanges mass with its surroundings. It may exchange energy with its surroundings in the form of heat and work, but energy transfer is not a necessary condition for a system to be an open system. In other words, an open system doesn't have to exchange heat or work with its surroundings at all. An open system, which typically encloses a device involves mass flow through its inlet and outlet. The outdoor condensing unit of an air conditioner may be treated as an open system because the coolant can enter and leave the condensing unit (the system) via its connecting coolant lines. An isolated system is an idealized, hypothetical system. No device is absolutely isolated, in reality.

### c. Extensive and Intensive properties

From a macroscopic perspective, a system is viewed as a continuous, homogeneous matter called continuum, which consists of a huge number of interacting molecules distributed throughout the system. The interactions between the molecules are so frequent that the physical or bulk properties of the system do NOT depend on the behavior of individual molecules. This hypothesis is valid for a wide range of engineering applications. It allows the physical properties of a system, such as pressure, density, and temperature, to be defined as a continuous function at any point of the system.

The following thermodynamic properties are typically used to describe the interactions between a system and its surroundings: Mass; Pressure; Temperature, Volume and specific volume, Internal energy and specific internal energy, Enthalpy and specific enthalpy and Entropy and specific entropy. These properties can be classified into two categories based on their dependence on the mass of a system: Extensive Properties and Intensive Properties.

Let us consider a container of air at 101 kPa and 20$^{o}$C. If the container is divided into two compartments and all other conditions remain unchanged, the air in each compartment will be still at 101 kPa and 20$^{o}$C. The pressure and temperature of the air are not affected by the changing mass in each compartment; therefore, pressure and temperature are intensive properties. On the other hand, the mass and volume of the air in each of the compartments are different from the original values in the container. Both of them depend on the mass of the system; therefore, mass and volume are extensive properties. All specific properties are intensive properties, as they refer to the corresponding extensive properties per unit of mass, e.g., specific volume and specific internal energy.

### d. State, Process, and Cycle

If a system is isolated from its surroundings or is free from any unbalanced potential, such as forced flows of mass or energy, the system will eventually reach a uniform condition called equilibrium. A system in equilibrium has uniform properties throughout the system. The following equilibrium conditions are commonly considered in thermodynamics.

- A system that features spatially uniform temperature is in thermal equilibrium
- A system free from chemical reactions is in chemical equilibrium.
- If there is no tendency for a system to change its pressure over time, the system is in mechanical equilibrium
- A system consisting of a mixture of multiple phases, such as liquid water and water vapor, if the composition of the mixture remains constant over time, the system is in phase equilibrium

State refers to the condition of a system, which may be described by a unique set of properties, such as pressure, temperature, and specific volume. The state of a system in equilibrium is called the 'equilibrium state'. A system may change from one state to another state through a process. Let us consider a container of water initially at 10°C and 101 kPa, as an example. We set the water in the container as the system. The water is heated until its temperature reaches 50°C, while its pressure is kept constant at 101 kPa. We may say that the water undergoes a constant pressure, heating process with an initial state of 10°C and 101 kPa and a final state of 50°C and 101 kPa.

Typically, there are many possible paths that a system may take between two states; therefore, the exact path of a process is extremely important and must be clearly specified to describe a process! Some common processes are: Isobaric Process, Isochoric Process, Isothermal Process, Adiabatic Process, and Isentropic Process.

### e. Working Principle of a 4 Stroke Engine

- Intake stroke: During the intake stroke, the inlet valve opens, and the outlet valve remains closed. Air is drawn into the cylinder as the piston moves to the bottom dead center (BDC).
- Compression stroke: During the compression stroke, both valves remain closed. The air is compressed as the piston moves from BDC to the top dead center (TDC).
- Ignition and power stroke: During this stroke, both valves remain closed. The piston is at TDC momentarily while the fuel-air mixture is ignited by the spark. The burning of the fuel-air mixture generates a large force, pushing the piston from TDC to BDC.
- Exhaust stroke: During the exhaust stroke, the outlet valve opens, and the inlet valve remains closed. The piston remains at BDC momentarily, allowing a certain amount of heat to be released to the surroundings. Then the piston moves from BDC towards TDC to reject the exhaust and heat to the surroundings.

## Reading Material: Cutting Tool Materials

Learning Objectives: After completing the chapter, the participants will be able to:

- Understand machinability and the factors affecting it
- Explain the role of cutting tool materials in machining
- Identify different types of cutting tool materials
- Distinguish materials based on their properties
- Relate tool material properties to machining performance
- Select suitable tool materials for different machining conditions

### a. Work Materials and Machinability

In machining operations, a wide variety of materials are encountered, each differing in structure, composition, and mechanical properties. These differences have a direct influence on ease with which a material can be cut. Among the various factors that affect machinability, the internal structure of the material plays a significant role. Materials possessing similar microstructures often exhibit similar machining characteristics, even when their compositions are not identical.

Hardness is another important factor that governs machinability. In general, harder materials are more difficult to machine than softer ones. As the hardness of a material increases, greater force is required to remove material, and higher temperatures are generated at the cutting zone. These elevated temperatures, if not controlled, may exceed the permissible limits of the cutting tool, leading to rapid wear or failure. For this reason, harder materials are typically machined at lower cutting speeds.

However, hardness alone cannot always be relied upon as an indicator of machinability. Materials with the same hardness may behave differently during machining due to variations in their internal structure. In practical applications, though, hardness is often used as a convenient measure, since it is easier to determine than microstructural characteristics.

### b. Cutting Tool Materials

The performance of a machining operation is greatly influenced by the material of the cutting tool. During cutting, the tool is subjected to severe conditions, including high temperatures, friction, and mechanical stresses. Therefore, the material used for cutting tools must possess certain essential properties to function effectively.

A suitable cutting tool material must be able to retain its hardness at elevated temperatures, resist wear, and withstand mechanical and thermal shocks. It should also provide sufficient strength to resist deformation under cutting forces. The ability of the tool material to maintain these properties during operation determines its effectiveness and service life.

The selection of cutting tool material has a direct impact on cutting speed, tool life, and the quality of the finished surface. Hence, it is an important factor in determining the overall efficiency and economy of the machining process.

### c. Types of Cutting Tool Materials

#### Carbon Tool Steel

Carbon tool steel is one of the earliest materials used for cutting tools. It is commonly used for manufacturing simple tools such as drills, taps, and reamers. Although it can be hardened to a certain extent, its ability to retain hardness at elevated temperatures is limited. As a result, carbon tool steel is not suitable for high-speed cutting operations and is generally used at relatively low cutting speeds.

#### High-Speed Steel

High-speed steel represents a significant improvement over carbon tool steel and is widely used in machining operations. It possesses the ability to retain hardness at much higher temperatures, which allows it to be used at higher cutting speeds.

High-speed steel can be hardened to a high level and maintain sufficient hardness even when exposed to the temperatures generated during cutting. This property enables it to perform effectively under conditions where carbon tool steel would fail. In addition, high-speed steel is tough and can withstand considerable mechanical stress, making it suitable for a wide range of applications.

The alloying elements present in high-speed steel, such as tungsten, molybdenum, chromium, and vanadium, contribute to its hardness, wear resistance, and heat resistance. Variations in composition lead to different grades of high-speed steel, each suited to specific applications.

### Cemented Carbides

Cemented carbides are considerably harder than high-speed steel and offer excellent resistance to wear. They are capable of retaining their hardness at much higher temperatures, which makes it possible to use them at significantly higher cutting speeds.

Because of their high hardness and heat resistance, cemented carbides are particularly suitable for operations requiring high productivity and good surface finish. However, they are more brittle than high-speed steel and are therefore less capable of withstanding shock or interrupted cutting.

Different types of carbides have been developed to suit various machining conditions. Some are designed to resist abrasion, while others are formulated to reduce wear caused by high temperatures and cutting action. Coated carbides further enhance performance by providing an additional layer that improves wear resistance and allows for higher cutting speeds.

### Other Tool Materials

Several advanced materials are used for specialized machining applications. These include ceramics, cermets, diamonds, and cubic boron nitride. These materials can operate at very high temperatures and cutting speeds, but they are generally more brittle and are used under controlled conditions.

### d. Relationship Between Tool Materials and Performance

The performance of a cutting tool is closely related to the properties of the material from which it is made. One of the most important relationships is between hardness and wear resistance. Tool materials with higher hardness generally exhibit better resistance to wear and are capable of maintaining a sharp cutting edge for a longer duration. However, increased hardness is often accompanied by reduced toughness, making the tool more susceptible to chipping or fracture.

Temperature also plays a critical role in determining tool performance. During machining, the temperature at the cutting zone can rise significantly. Tool materials that are able to retain their hardness at elevated temperatures can operate effectively at higher cutting speeds. This property, often referred to as hot hardness, is essential for high-speed machining.

Toughness is another important consideration, particularly in operations involving heavy cuts or interrupted cutting. Materials with higher toughness are better able to withstand mechanical shocks and are less likely to fail under such conditions, although they may wear more quickly than harder materials.

Thus, the selection and performance of cutting tool materials are governed by a balance between hardness, toughness, and temperature resistance. The choice of a suitable tool material depends on the specific requirements of the machining operation, including the nature of the workpiece material, cutting conditions, and desired productivity.

### Reading Material : Data Structures: Array

Learning Objectives: After completing the chapter, the participants will be able to:

- Understand the concept and structure of arrays
- Identify different types of arrays
- Explain common operations
- Relate structure to performance
- Apply arrays in different contexts

### a. Introduction

In computer science, data is often required to be stored and processed in an organized manner so that it can be accessed efficiently. One of the most fundamental ways of organizing data is through the use of arrays. Arrays provide a simple yet powerful mechanism for storing a collection of elements of the same type in a structured form. An array can be defined as a collection of similar data elements stored in contiguous memory locations. Each element in an array is identified by its position, known as its index. This indexing allows direct access to any element in the array, making arrays highly efficient for retrieval operations. Arrays are widely used in programming because they form the basis for many other data structures and algorithms.

### b. Representation of Arrays

An array stores elements in consecutive memory locations. Once the starting address of the array is known, the address of any element can be calculated using its index. This contiguous storage provides a significant advantage: any element can be accessed directly without traversing the entire structure. However, it also introduces certain limitations, particularly in terms of flexibility and memory usage.

### c. Types of Arrays

*One-Dimensional Arrays:* This is the simplest form of an array. It represents a list of elements arranged in a single row. Each element is accessed using a single index. *Two-Dimensional Arrays*: This may represent data in the form of rows and columns, similar to a table or matrix. Each element is identified by two indices: one for the row and one for the column. *Multi-Dimensional Arrays*: These have more than two dimensions. These are used in more complex applications, such as representing three-dimensional spaces or higher-dimensional data.

### d. Operations on Arrays

Traversing refers to accessing each element of the array sequentially. This operation is commonly used for displaying elements or computing values. *Insertion* involves adding a new element at a specified position. This requires shifting existing elements to create space. *Deletion* involves removing an element from a specified position. Elements must be shifted to fill the gap. *Searching* is the process of finding the location of a particular element in an array. *Merging* involves combining two arrays into a single array.

### e. Arrays and Memory Considerations

Arrays use contiguous memory allocation, which allows efficient access but imposes constraints. The size of an array is usually fixed at declaration, and resizing requires creating a new array and copying elements.

### f. Relationship Between Structure and Performance

The performance of arrays is closely linked to their structure. Direct indexing allows fast access to elements, making retrieval efficient. However, insertion and deletion operations require shifting elements, increasing the time required. Thus, arrays involve a trade-off between efficient access and limited flexibility.

## 2.4 Self Awareness

*Participants, take a few moments to reflect on both the small group work and the large group sharing using the prompts below*

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- **First:** write your feedback for your own group.
- **Second:** write feedback for the other groups.
- **Third:** Share these with the large group.

a. Feedback for my own group:

- What were some strengths of our group during small group discussions and sharing?
- What is one area our group could improve?

b. Feedback for another group:

- What worked well in the other group's processes or sharing?
- What is one suggestion you would like to offer to help the other groups improve further?

## 2.5 Facilitator Wrap Up: Learning as Multi-Dimensional

*Participants: Here are some engagement strategies that we experienced a while ago. Please take a few moments to read them silently and summarize them in your own words. After that, I may also add a summary, if needed, and connect ideas.*

Learning is inherently multi-dimensional and therefore requires a range of experiences to meaningfully engage learners in the process of learning. These include opportunities to think and reason (cognitive), to observe and draw connections across experiences (perceptual), to work in teams and listen to understand (social); to work with hands or experience sounds (psychomotor); to demonstrate processes and skills (behavioral).

### a. Concept Mapping (Engagement Strategy 7)

Concept Mapping promotes meaningful student engagement. *Students can be given short paragraphs, case studies, or excerpts from a text and asked to draw concept maps.* Through this, they can highlight key principles, ideas, relationships, factors, variables, and make connections between theory and life situations.
Teachers may use concept maps as a visual tool to provide learners with an effective summary of a topic or sub-topic. Students see things on a whole rather than in isolation. Concept mapping provides a visual- sensory experience. Teachers may plan similar engagement using *sounds or other visuals* when learners require sensory awareness. This can be in the form of *images, audio, video, or use of some processes in a science laboratory.*
*Going forward, we may use* digital concept-mapping tools or technology-enabled tools such as Mindomo, The Brain, and Miro to create virtual concept maps.

### b. Small Group Work (Engagement Strategy 8)

When students engage in small groups to explore a task, they learn to work independently towards a shared goal. They discuss, analyze, express ideas, ask questions, and solve problems within the group. They learn to generate ideas and create something new. It is important to engage students consistently in small groups. E.g. w*orking on assignments or projects, practicing tasks by supporting each other, discussing a reading, making a poster, or a diagram.*

### c. Large Group Sharing (Engagement Strategy 9)

When small group activities are followed by large group sharing, learners learn to organize and synthesize ideas. They draw comparisons, learn from various perspectives, refine their own learning, and learn to express ideas clearly. *Large group sharing can take many forms, such as inviting one or two students to present their written responses, explain their problem-solving process, or share insights from a PPT presentation.* Thus, this can be done during any time of the class and after routine activities in the class or home tasks and not necessarily after a big project.

### d. Consolidation of Learning (Engagement Strategy 10)

After sustained engagement with a topic, discussion, or a process, it is important to pause and revisit key ideas before moving to another topic. Such closure strengthens conceptual understanding and encourages learners to imagine how similar situations might unfold in different contexts. They begin to examine not only *what* they have learned, but also *how* they think, feel, and respond. Over time, they learn to question their beliefs or assumptions. *Recap, Key Takeaway and Facilitator Wrap-up are some ways to consolidate learning.*

A moment of recap and synthesizing key takeaways helps learners organize their thinking, develop more clarity and opportunities to internalize important concepts. *E.g. writing key points, sharing an interesting idea from the text or one question that remains with you after a text or a class.*

Following a learning activity, a thoughtful facilitator wrap-up helps clarify doubts and draw meaningful conclusions. Teachers may do this in different ways: *introducing a relevant concept or theory after an activity or highlighting patterns emerging from student responses*. When learners understand the theory behind a particular activity, they can apply it more effectively and with greater depth.

**e. Peer Feedback (Engagement Strategy 11)**

Peer feedback is a powerful approach to engage learners in meaningful learning. To ensure that peer feedback is meaningful and supportive, it is important to use clear and structured prompts. Feedback is the most effective when connected to self-assessment, *i.e. students first reflect on their own work before offering feedback to others*. This process enhances self-awareness.

Students may be asked to give feedback to each other for tasks they have done as a group. As learners examine both their own learning and the observations and interpretations of their peers, they deepen their understanding. They begin to appreciate diverse perspectives and ways of thinking. They learn the importance of peer learning. Simple ways of initiating peer learning in class include Gallery Walk, Appreciation Sticky Notes, Sharing a group work, and Asking Clarifying Questions to each other.

## 2.6 Session Two Recap and Takeaways

*Participants, thank you for your participation in FAB sessions so far.*

- As we meet tomorrow, let us come prepared with a task. Here are some guidelines for it:

- **First**: Please review your notes from Session 2, reflect on your experiences, and identify one key takeaway that you would like to remember and carry forward.
  Note down these observations here and share them with all tomorrow.

- **Second**: Please visit the previous 4 Cs table (section 1.4). Once again, in column B, place a ✓ against the aspects of the 4 Cs that you have experienced during session 2 or you were already aware of prior to it.
- **Third**: In the same table, identify 4 Cs that your students demonstrate in classroom and ✓ mark in column C. In column D, identify at least 4 specific skills (one each from the 4 Cs) that you would like to consciously prioritize and strengthen among your students going forward.
- **Fourth**: We request two members to prepare a brief recap and reflection on today's session and share it during tomorrow's meeting. We will begin tomorrow's session with this activity.

# SESSION 3:

# EMBRACING THE LEARNING JOURNEY

## 3.1 Designing a Learning Plan

*Participants form small groups of 5–6 members who belong to the same or related trade and collaboratively design a learning plan. Follow these guidelines:*

**First:** Pick up a topic or concept from your syllabus that you are going to work on in the immediate future. You may also use any topic from the three reading materials that you used in the previous session.

a. Topic Overview
- Name of Topic and Sub-Topics – for which the learning plan needs to be designed
- Objectives of the chosen topic (not entire chapter)
- Learning Outcomes of the Topic. This includes one of the 4 Cs you have prioritized for your students
- Prior knowledge/ experience of the students of the topic

b. Time Duration
- Estimate time that you will need to complete that topic

**Second**: Create a persona of your learner by providing the following details to AI and generating relevant responses for your learning plan.

c. Students' Information
- Current Grade, Year, Semester
- Branch of Engineering or Stream
- Number of students per class
- Socio-eco. context (semi-urban, urban, rural, home language, family or community strengths, available resources -village/ town)

**Third**: Use the prompts (not an exhaustive list) given in the Learning Plan Template to make your lesson plan choices.
- Have a discussion in your group and decide how you visualize a lesson for meaningful student engagement.
- Discuss which tasks students can complete independently, in collaborative group work, and structured instruction. Thus, balance 'teacher-led' and 'student-led' activities and make effective choices.

**Fourth**: Approach AI and ask:
- The right question and extract relevant information that suits your classroom context.
- Refine your ideas, share alternate perspectives, provide resources like visuals / PPT/ soundtrack, and specific instructions for each activity.

Participants, now use a chart or a flip chart to note down the following and complete your Learning Plan:

| Learning Plan Template<br>(Teacher Led, AI Supported and Learner Centered) | |
|---|---|
| 1. Context Setting<br><br>Describe your idea to AI as to how you would want to begin the class. Ask AI to enhance your learner engagement idea with:<br><br>• Engagement Strategy<br>• Specific instructions for different tasks<br>• Tools, Resources<br>• Questions / Prompts between a lesson | |
| 2. Development of the Lesson<br><br>Describe your idea to AI as to how you would want subsequent activities to unfold. Ask AI to enhance your engagement idea with:<br><br>• Required Sequencing<br>• Specific instructions for different tasks<br>• Tools, Resources<br>• Questions / Prompts<br>• Integration of one of the 4 Cs prioritized | |
| 3. Assessment of Learning<br><br>Describe your idea to AI that ensures students are learning. Ask AI to<br><br>• Provide sample questions / prompts<br>• Peer feedback ideas to support each other<br>• Teacher's feedback ideas to support students | |
| 4. Consolidation of Learning<br><br>Describe how you would conclude the lesson meaningfully. Ask AI to refine strategies for<br><br>• Summarizing the lesson/ topic<br>• Application of core concepts, principles in life | |

## 3.2 Gallery Walk

*Participants, a gallery walk introduces multiple approaches, encourages the sharing of ideas, and promotes appreciation and peer learning.*

Place your Learning Plans on the table or stick them on the wall

- Walk around and look at each other's plans.
- Share an emoji that best expresses your appreciation with each other. 🌟 👏 💡 💖
- Actively observe and engage with the displays of your colleagues

A teacher can create simple gallery-walk experiences in the classroom by encouraging students to appreciate and learn from one another as they share their work or ideas. They can guide students to notice how their peers have approached the same task differently and reflect on what they might learn from their classmates. Through such small, purposeful and flexible opportunities for peer learning, students gradually develop an informed and open mind, learning to value diverse perspectives and approaches.

## 3.3 Facilitator Wrap Up: Teachers as Architects of Learning

There are many lesson plan templates and online tools that can support the planning process. However, truly effective student engagement depends on teachers' professional judgment in tailoring their plans to the specific context and needs of their learners.

*Participants, Here are some descriptions of strategies that we experienced a while ago. Please take a few moments to read them silently and summarize them in your own words. After that, I may also add a summary, if needed, and connect ideas.*

a. **Leveraging Artificial Intelligence:**

AI can support the creation of personalized content that responds to students' diverse needs and learning pathways. E.g. designing an entire learning plan or developing some of its smaller components, suggesting engagement activities, questions for formative assessments, practice worksheets, case studies, or discussion prompts for small or large group work.

AI can support teachers in summarizing chapters, identifying key concepts, comparing ideas, generating examples, and even creating images or scenarios that stimulate classroom dialogue.

Going forward, teachers may use a variety of AI tools. For e.g.

- ChatGPT (OpenAI) / MagicSchool AI / LessonPlan.ai
  - To generate entire lesson plan or select components such as projects, prompts/ questions or real-life situations and varied activities

- Coursebox AI
  - To generate lesson plan or PPT slides

- Lessons quill
  - To generate a sequence of learning aligned to lesson objectives

- Eduaide.AI / Educator Lab
  - To generate lessons, assessment tools, practice resources

- Canva for Education / Slides AI / Beautiful.ai
  - To generate visual content and presentation

- Quizizz AI / Quillionz / Worksheet Generators / Wayground / Educator Lab
  - To generate assessment tools or practice materials

- Google Gemini for Education
  - To generate interactive and multimedia resources

However, to receive high-quality and relevant responses from AI, teachers must actively "drive" the thinking and the learning design. This means deciding which tasks students can complete independently or in collaborative group work, and which topics require structured instruction or guided facilitation. Secondly, teachers need to refine questions or prompts for AI thoughtfully based on their classroom contexts and priorities and ensuring an alignment with the larger purpose of education.

AI can generate options for teaching- learning, but it is the teacher who determines direction, depth, and intention. Thus, AI becomes a powerful support tool, while the teacher remains the architect of learning.

At times, teachers can involve students in shaping their own learning plans. Through informal conversations, teachers can invite students to share what they consider important and what they would like to explore or work on in subsequent classes (whether a particular topic, skill or area of interest). Such practices give students a voice in their learning and contribute to a more positive, participatory, and egalitarian classroom environment.

### b. Flexible Approach to Learning Plans

Effective Learning Plans create clarity, direction, and engagement in the classroom. Students relate well with concepts and can see their application in real life. They help nurture the 4 Cs.

A learning plan is not a prescription or a fixed template. It is a living document responsive to the needs of learners, the dynamics of the classroom, and emerging insights during the class. The interactions between teachers and students, emerging questions, and evolving understanding shape and guide the overall flow and direction of the class.

Thus, once the design is ready, teachers must again "drive" the implementation by choosing meaningful learning pathways. Learning plans need to evolve with contextual realities of a classroom.

Important:

What matters is not whether the teacher has designed a perfectly structured lesson plan where all the 4 Cs are visibly mapped and documented. What is important is focusing on small and consistent shifts in teaching–learning practice. Sustainable change does not come from perfect documentation. It comes from everyday practice.

*Note: In this session, we used a standard learning plan template. In practice, teachers may use the format prescribed by their department or institution to design and work on their learning plan.*

## 3.4 Small Steps, Lasting Impact

FAB is the beginning of a process of continuous reflection, growth, and improvement as a facilitator. The real impact of the program lies in the small, intentional steps you take to apply your learning in practice and strengthen your facilitation over time.

*Participants sit together in a large circle. In column A, is a list of concepts and strategies we engaged in during the sessions.*

- Tick (✓) the ones you explored in the 3 day's session in column B.
- Tick (✓✓) those you feel confident about applying to your classroom in column C.

| Small Steps for Learning | | |
|---|---|---|
| (A) The 4 Cs | B (✓) I have explored | C (✓✓) I am confident in using in class |
| **Critical Thinking**<br>I will be able to engage learners-<br>• With a PPT, a video, a case study, a lecture using prompts<br>• By applying purposeful questions across a lesson<br>• By encouraging them to ask questions<br>• By using concept maps<br>• With recaps, wrap-ups and key take aways after a lesson | | |
| **Communication**<br>I will be able to engage learners-<br>• In large group sharing tasks using prompts<br>• By encouraging writing before speaking<br>• By prompting clarificatory questions<br>• Enabling peer feedback and affirmations<br>• By modeling careful listening and acknowledging challenges | | |
| **Collaboration**<br>I will be able to engage learners-<br>• In small group work using structured prompts<br>• By facilitating expression of gratitude for each other<br>• With shared reflections on feelings and beliefs | | |
| **Creativity**<br>I will be able to engage learners –<br>• By building students' purpose in learning<br>• By encouraging their questions, ideas in between the lesson<br>• By designing learning plans with the use of AI.<br>• By initiating small steps that build on to make an impact | | |

## 3.5 Affirmations

Thank you for your participation and your valuable contributions. Lots of appreciation!

*As we close, take a moment to appreciate (other than the facilitator) any one or more participants whose participation, insights, or values resonate with you.*

Write your affirmation on sticky notes and gently place them on their shoulder as a gesture of acknowledgement and encouragement.

## 3.6 Way Forward

*Participants use the given prompts to recall and reflect FAB sessions so far. After this, share your insights, key learning, or personal realization with each other.*

a. **What are my personal experiences or values that I am able to connect with the sessions?**
E.g. I value curiosity in personal life, and I realize that I can create opportunities for students to ask questions.

b. **What is one belief or way of thinking about teaching-learning shifted for me during the session.**
- E.g., I am beginning to value 'depth' that enables students to truly engage.
- E.g. I used to see myself as the primary source of knowledge, but now I recognize the importance of student-led work that fosters independent learning.

c. **What is 'one' engagement strategy from the (✓✓) column that I am considering applying in my classroom? How do I visualize doing that?**

d. Just as we explored youth unemployment in this session, what is one topic or issue I am curious about and would like to investigate further on my own?

e. **A Commitment –** Before we close, take a moment to complete this sentence:

"One teaching practice from the list below that I will intentionally use in my classroom within the next three weeks is

**Note**: The list includes strategies 1–11 that you have experienced during these sessions, as well as strategies 12-16 that you may already be using in your classroom.

- Building purpose in Learning (Engagement Strategy 1)
- A PPT with Prompts (Engagement Strategy 2)
- Writing Before Speaking (Engagement Strategy 3)
- Reflecting on Feelings and Beliefs (Engagement Strategy 4)
- Questions Across a Lesson (Engagement Strategy 5)
- Students Asking Questions (Engagement Strategy 6)
- Concept Mapping (Engagement Strategy 7)
- Small Group Work (Engagement Strategy 8)
- Large Group Sharing (Engagement Strategy 9)
- Consolidation of Learning (Engagement Strategy 10)
- Peer Feedback (Engagement Strategy 11)
- Experiments (Engagement Strategy 12)
- Project Work (Engagement Strategy 13)
- Demonstration (Engagement Strategy 14)
- Reading (Engagement Strategy 15)
- Practice Tasks (Engagement Strategy 16)

After writing your commitment, take a picture of it and post it on WhatsApp. Remember to keep your commitment by taking small, intentional steps to bring lasting impact to your classroom. Once you have practiced what you committed to:

- Share a photo of your practice on WhatsApp.
- Share a short write-up about your experience: what you tried, what you noticed, and what you learnt.
- Contribute to each other's learning by responding to and learning from your peers' experiences.

Together, let's build a learning community where we support, learn from, and inspire one another.

# SESSION 4:

# LIVING THE LEARNING JOURNEY

## 4.1 Peer Learning

*Participants divide yourself in 5 groups. Each group will take turns facilitating a lesson for each other by using one of the following allotted strategies:*

- Group 1: Experiments (Engagement Strategy 12)
- Group 2: Project Work (Engagement Strategy 13)
- Group 3: Demonstration (Engagement Strategy 14)
- Group 4: Reading (Engagement Strategy 15)
- Group 5: Practice Task (Engagement Strategy 16)

The focus of this activity is not on teaching the content, as your colleagues may already be familiar with various topics. Instead, demonstrate a classroom where learners are participating, thinking, discussing, collaborating, and learning together. The emphasis should be on how you facilitate learning rather than what you teach.

Each group is responsible for collaboratively planning, facilitating, and reflecting on the lesson they present to their peers. All members of the session are expected to actively participate throughout the activity. Once all three lesson presentations have been completed, the entire group will engage in debrief session.

The following steps will guide you to complete this activity:

**Step 1: Research**

*Read the brief description of a few additional strategies and watch the reference videos. Learn about the purpose, their role in the teaching–learning process and gather practical ideas for implementation. Discuss the strengths and possible classroom applications of each strategy with your peers. Make notes of your discussions.*

**a. Experiments (Engagement Strategy 12)**

These strategies promote experiential learning. Learners engage directly with materials, processes, and authentic problems while investigating questions, exploring ideas, designing solutions, testing their thinking, and reflecting evidence. As they plan, select resources, test strategies, record observations, and share their findings, they develop conceptual understanding as well as the 4 Cs. Learners test a principle or hypothesis by observing situations under controlled conditions.

Example (Mechanical Engineering):

- Students investigate how blade angle affects cutting efficiency. They test cutting tools with different blade angles under the same material, speed, and force conditions. They then measure cutting time, surface finish, and energy required to determine the most effective blade angle

Suggested Videos:

- **Scan QR Code:** Edutopia (2015) Inquiry-Based Learning in the Science Classroom

This video shows how a science class starts with a meaningful question for students to investigate, gather evidence, to discuss and analyse and draw conclusions.

- Scan QR Code: Crash Course. (2017, May 22). The scientific method: Crash Course Kids #14.1 [Video]. YouTube.

  This video demonstrates how an inquiry begins with observation and questioning. It illustrates the steps of the scientific method and shows how teachers can encourage curiosity, evidence-based reasoning, and critical thinking in the classroom.

- Scan QR Code: The Royal Society. (n.d.). Brian Cox school experiments.

  This resource features a collection of engaging classroom experiments designed to bring scientific concepts to life through hands-on exploration.

### b. Project Work (Engagement Strategy 13)

In Project Work, learners solve a real-world problem or create a meaningful product over an extended period by integrating knowledge, skills, and multiple concepts. They plan, investigate, design solutions, create prototypes, test and refine their ideas. They make a presentation of their work. Throughout the process they collaborate with others and reflect on their learning.

Example (Civil Engineering):

- Students design a rainwater harvesting model suitable for their college campus. The project includes a site survey, runoff calculations, storage capacity estimation, cost analysis, and the development of a scale model or digital design proposal.

Suggested Videos:

- Scan QR Code: Edutopia. (2019, May 15). How does project-based learning improve science education? [Video]. YouTube.

  This video demonstrates how project work connects classroom concepts with real-life situations. Carefully designed projects enable students to collaborate, make inquiries, and create solutions.

- Scan QR Code: PBL Works. (2010, December 9). Project based learning: Explained [Video]. YouTube.

  This video demonstrates how key elements in the project help build content knowledge and essential skills.

### c. Demonstration (Engagement Strategy 14)

In a Demonstration, the teacher or learners make an abstract concept, process, or skill visible by showing how it works. Demonstrations help learners observe correct procedures, understand underlying concepts, and develop confidence before practicing the skill themselves. Example (Automobile Engineering): Students observe a demonstration of carburetor disassembly and reassembly. They then independently dismantle, identify, document, and reassemble each component while explaining its function in the fuel–air mixing process.

Suggested Videos:

- Scan QR Code: Teachers Institute. Enhancing Learning through the Demonstration Method.

  This video shows how abstract concepts are visible through demonstration. It guides three stages of this process – before, during and after. All together they make demonstrations effective rather than being a teacher-only activity.

- Scan QR Code: Science Education Resource Center (SERC), Carleton College. –

  This video shows how demonstrations are effective when they involve an interactive process. They are not just show and tell, but learners predict, observe, record evidence and explain outcomes

### d. Reading (Engagement Strategy 15)

Reading enables learners to construct meaning by engaging critically with written, visual, or digital information. Through analysis, questioning, interpreting, comparing, evaluating, making connections, and applying concepts to authentic situations, learners deepen their conceptual understanding. After this, they demonstrate their learning through different processes: by summarizing, explaining, illustrating, interpreting information, drawing conclusions, organizing information, or responding to analytical questions.

Examples:

- Mechanical Engineering: Students analyze two maintenance manuals. They compare preventive and corrective maintenance procedures, identifying the contexts in which each approach is appropriate.
- Civil Engineering: Students analyze a bridge failure report. They identify the technical, structural, environmental, and safety factors that contributed to the collapse.

Suggested Videos:

- Scan QR Code: YouTube. (n.d.). Close reading strategy teachers

  This video demonstrates how reading helps uncover meaning as students analyze ideas, identify, evidence, make connections, and think critically.

- Scan QR Code: YouTube. (n.d.). Reading comprehension across the curriculum

  This video shows how students interpret, analyze, and apply information across various disciplines.

### e. Practice Task (Engagement Strategy 16)

Practice Tasks provide opportunities for learners to apply, repeat, and refine newly acquired knowledge or skills in a variety of contexts. Through repeated practice, feedback, and reflection, learners strengthen understanding, improve performance, and build confidence and fluency. Practice tasks may include solving numerical problems, applying concepts to new situations, making presentations, peer teaching, reflective writing, coding, or practicing technical procedures.

Examples:

- Computer Science: Students develop programs using arrays with increasing levels of complexity.
- English Communication: Students practice professional interview with their peers. They improve their performance based on the feedback they receive from them.
- Civil Engineering: Students repeatedly estimate material quantities using different building plans.

Suggested Videos:

- Scan QR Code: Microteaching. (n.d.). Microteaching: A teacher training technique [Video]. YouTube.

  This video demonstrates the process of microteaching that incorporates constructive feedback and opportunities to research. It enables educators to practice and refine instructional skills in a supportive environment.
- Scan QR Code: Edutopia. (2025, September 26). Making retrieval practice a classroom routine [Video].

  This video demonstrates how learning becomes lasting when students are given regular opportunities to repeat and apply what they know. Through purposeful questioning, low-stakes activities, and consistent practice, they actively use prior knowledge.

### Step 2: Planning

*Participants, now that you have explored a student engagement strategy, work with your group to select a topic from your syllabus.*

*Discuss:*

- How will you engage participants with that strategy?
- How will you sequence your lesson?
- What natural and other available materials from the surroundings will you use?

Step 3: Facilitation and Observation

*Participants, discuss and allocate facilitation roles and responsibilities within your group. Ensure that every member has an opportunity to facilitate a part of the lesson and contribute meaningfully to the learning experience.*

- As one group facilitates the lesson, the other groups will participate as learners. In addition, they will observe the lesson silently, taking notes on the facilitation process, student engagement strategies, learner participation, and assessment practices along the way.

4.2 Debrief

A debrief is a structured discussion that takes place after an activity or learning experience. Participants reflect on what happened; they celebrate successes, identify challenges, and suggest ways to strengthen teaching and learning in the future.

*Following the facilitation, all participants, including the facilitator, engage in a structured reflective discussion. Write and consolidate your observations based on the guidelines given below.*

a. How would you describe your overall experience?

b. What was the one moment or insight that stood out most for you, and why?

c. Where did you engage with the 4 Cs: Critical Thinking, Creativity, Collaboration, and Communication?

d. Which dimension of learning and facilitation seemed most evident throughout the session: the Head (thinking), the Hands (doing), or the Heart (connecting)? What makes you say that?

e. What elements would you definitely retain in your future tasks? What would you redesign or strengthen for future sessions, and why?

## 4.3 Meaningful Learning

*Participants read the following passages and summarize the key message.*

a. Facilitation

Facilitating learning requires thoughtful judgement and intentional instructional design. Teachers create learning experiences that encourage students to explore ideas, ask questions, discuss concepts, communicate and collaborate effectively, apply learning, solve problems, and reflect on their learning.

Experiments, Project Work, Demonstrations, Reading, and Practice tasks engage students cognitively, socially, and emotionally. They engage the Head (thinking and understanding), the Heart (feelings, values, and relationships), and the Hands (doing, creating, and applying).

Teachers build on learners' prior knowledge and guide them in constructing understanding through active engagement, inquiry, discussion, and reflection. They scaffold learning and create a safe and inclusive environment where students feel confident in participating, learning from mistakes, and taking intellectual risks. Through ongoing formative assessment, they adapt instructions.

Effective facilitators are also lifelong learners who are curious, continuously seek new knowledge through research and apply gained knowledge. Today, we researched a range of student engagement strategies and demonstrated self-learning by exploring, discussing, and applying new ideas.

Let us continue this practice by remaining curious and encouraging our students to develop the same habit of inquiry, research, and independent learning.

b. Professional Learning Community

Sustained improvements in teaching are most likely when educators engage in continuous collaborative learning besides one-time training programs. Through Professional Learning Communities, teachers regularly reflect on their teaching-learning practice, examine student learning, discuss challenges, and refine their teaching. Through professional dialogue and shared responsibility, there is strengthening of teacher capacity, promoting continuous improvement, and contributing to enhanced student learning and well-being.

Today we experienced what collaborative professional learning looks like. Every discussion, lesson, observation, and reflection contributed to our collective learning.

Thank you for your openness, thoughtful participation, and willingness to learn from one another. Let us continue to build this community and take small, consistent steps for our students.

A Commitment: Before we close, take a moment to complete this sentence:

"One teaching practice I will intentionally use in my classroom within the next three weeks is

_____

_____

_____

_____

Thank You!!

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