Innovative Interventions to Improve Integration (Social & Academic) of Undergraduate STEM Students

Processing Learning Content (STEM FOCUS)

Overview of Intervention

What is Processing Learning Content?

- *Comprehend* abstract and technical material.
- *Connect* ideas across topics and disciplines.
- *Apply* knowledge to new problems.
- *Reflect* on their understanding and progress.

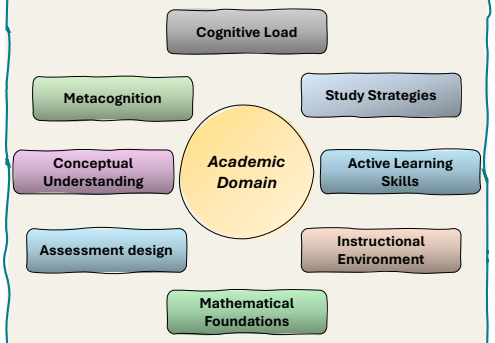
Outline of Activity:

- **F**rame the problem
- **O**rganise i.e. engage with the material actively
- **C**onnect concepts and applications
- **U**nderstand by applying examples
- **S**ynthesise i.e. form integrated knowledge

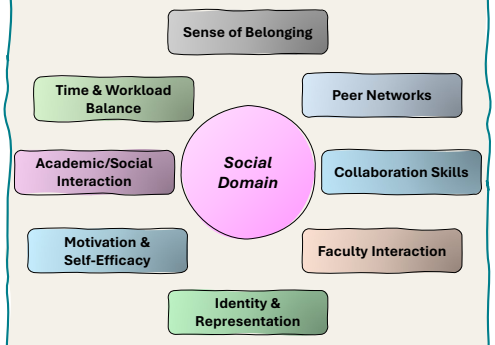
By Completing the task, students will...

- Develop *active learning* and *self-regulation skills*.
- Build *conceptual understanding* through *multiple processing strategies*.
- Strengthen *peer collaboration* and *academic belonging*.
- Improve *academic performance* and *confidence* in STEM coursework.

Academic Issues (Cognitive & Social)



Social Issues (Psychosocial & Environmental)



Data Collection Methods

Survey & Questionnaires: Pre and Post Intervention questionnaire. Post-intervention peer evaluation form.

Focus Groups / Interviews: For example, ask students "*What makes studying STEM material difficult?*"

Activity Observation: Note who participates, asks questions, collaborates.

Learning Analytics: Time spent on LMS, assignment patterns, quiz attempts etc.

Performance Data: Analyse trends by course or topic.

Peer / Mentor Reports: Peer feedback on group participation or concept discussions.

Reflection Journals or Portfolios: Students describe how they approached learning activities.

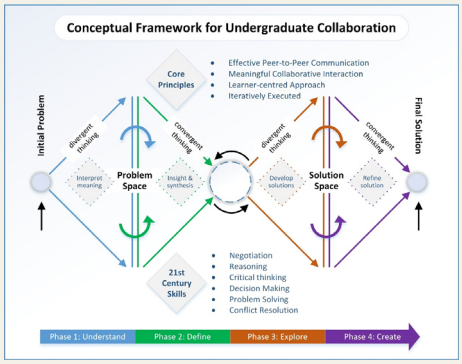
Outline of Intervention Activity

Over the course of a semester, first year undergraduate STEM students will undertake a set of tasks designed to help them actively process learning content i.e. moving beyond passive reading or note taking to a deeper understanding and application

The intervention will be structured as follows:

- **Duration:** 3-4 weeks
- **Frequency:** 1 task per week (may be linked to current course offerings)
- **Format:** Short, structured, skill-based activities
- **Integration:** Can be embedded in module lectures/tutorials

Individual Activity Structure



The double-diamond design represents the process of exploring a problem in a wider and deeper way (divergent thinking) and then focusing on the solution (convergent thinking).

Each diamond may be considered a space.

1. The ***problem space*** allows the students to get an in-depth understanding of the problem. It involves exploring challenges that arise and defining the problem correctly i.e. understanding why? and defining how?
2. The ***solution space*** is where the students can utilise a range of divergent cognitive tools to critically think and respond creatively to the problem. It is concerned with generating ideas and finding the right solution i.e. how to?

The collaborative process is guided by the core principles listed with a number of key 21st century skills also identified.

Inspiration for Individual Activities

Discover Engineering Activity Pack:
Available at: https://discovere.org/stem-activities/engineering-activities-for-students/

Engineering Activity Pack:
Available at: https://education.amey.co.uk/media/9222/engineering-activity-pack.pdf

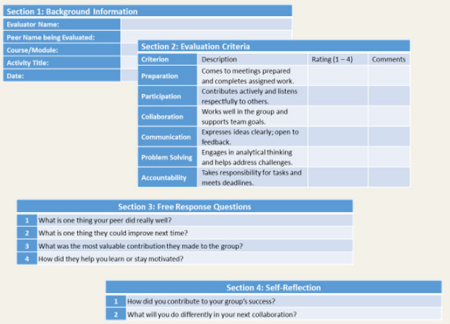
Engineering Challenge Pack:
Available at: https://education.amey.co.uk/engineering-challenge-pack/

Designing a contemporary STEM curriculum
Available at: https://unesdoc.unesco.org/ark:/48223/pf0000374146

Girlguiding Activity Pack
Available at: https://girlguidingulster.org.uk/assets/uploads/Girlguiding-activity-pack-ICE-Ulster_2023-10-11-090158_egme.pdf

Post-Intervention Peer-Evaluation Form

Purpose: This form helps students provide constructive feedback to peers in group or collaborative tasks. It promotes accountability, reflection, and teamwork - key skills for success in STEM



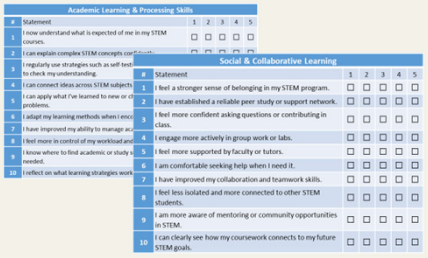
Post-Intervention Survey

Purpose: This questionnaire measures changes in students' confidence, learning strategies, and social integration in STEM after completing the intervention. Responses will guide targeted support and skill development..

Instructions: Please rate each statement honestly based on your current experience using the scale below.

Scale:

1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree



Synthesise Findings

1	Individual	Skills, confidence, mindset
2	Interpersonal	Peer & faculty relationships
3	Institutional	Curriculum & structure

Translate Findings into Actions

1. **Design workshops** on metacognition, peer learning, and workload management
2. **Create learning communities** or mentoring programs
3. **Train faculty** in inclusive and active learning environments
4. **Build tools** (like reflection worksheets or peer evaluation forms) that embed social-academic integration into coursework

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