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STEAM Project-based Learning

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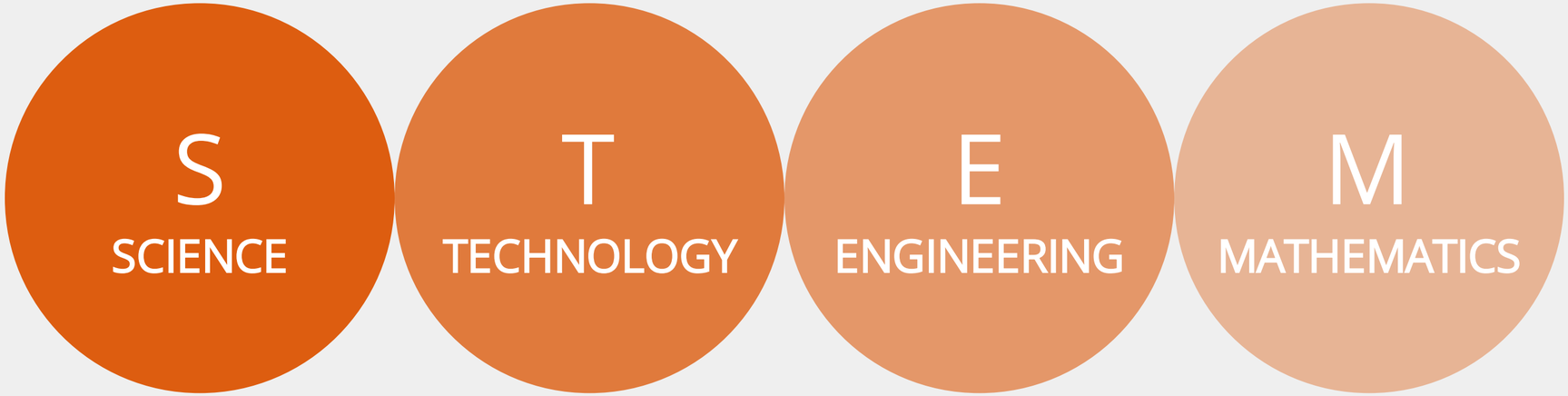
INTEGRATED APPROACH

In the last years, the European Union has advocated for implementing an integrated learning in



This implies crossing disciplinary boundaries to organize the curricular content

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WHY STEM EDUCATION?

SOCIETY CHANGES	About 65% of children today in primary education will work on unknown jobs (ITU, 2017)	Employment in STEM-related sector is expected to grow about 6,5% in 2014-2025 (CEDEFOP, 2014)	
EU ACTIONS	Training students on STEM competences to confront with present and future challenges	Recruiting students to pursue STEM-related careers to supply the demand workforce and to guarantee economic growth	Attracting girls to pursue science and engineering professions to guarantee economic growth (European Institute for Gender Equality, 2017)
CURRENT STATE	In many European countries the 25% of students do not achieve the minimum level of proficiency in maths and science (OECD, 2019)	The rate of STEM graduates in EU is increasing slower than in other countries	Significant differences between 15-year-old boys and girls were found on expecting to pursue science and engineering professions (OECD, 2020)

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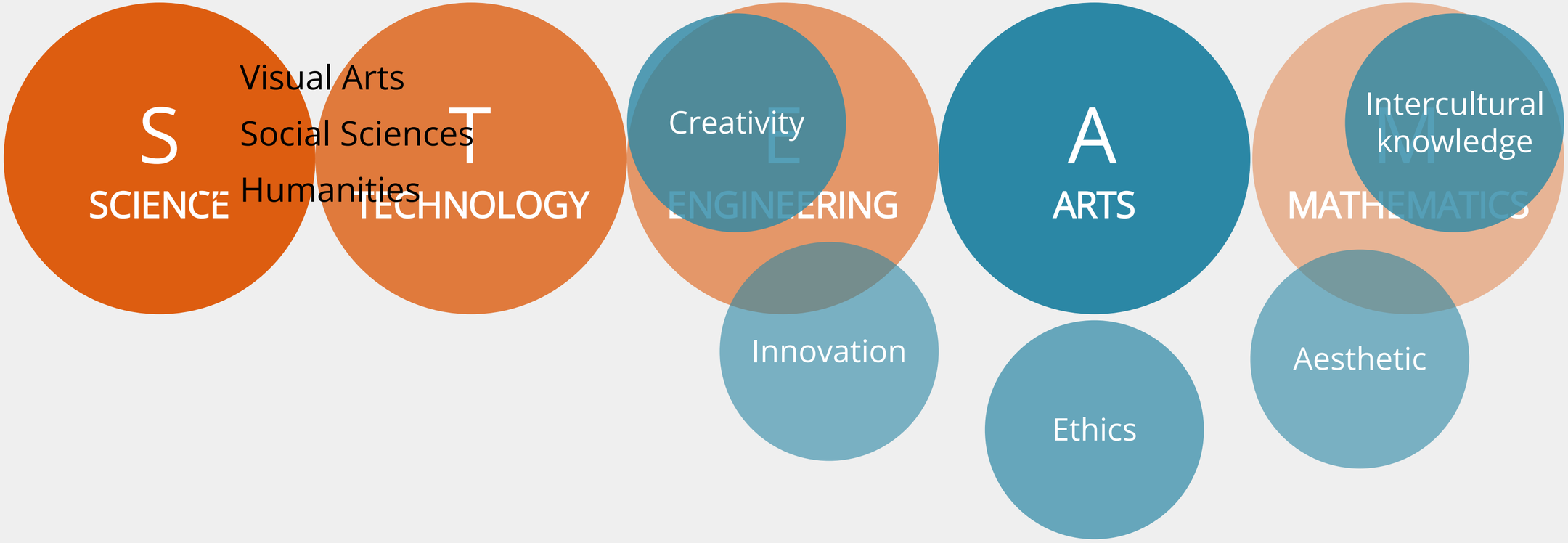
STEAM EDUCATION

Some researchers suggest that the EU actions would be more successful by emphasizing the Arts



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STEAM Education for Teaching Professionalism

LEARNING METHODOLOGIES

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STEAM education can be addressed through different learning methodologies, for example:

- Project-based learning (PBL)
- Game-based learning

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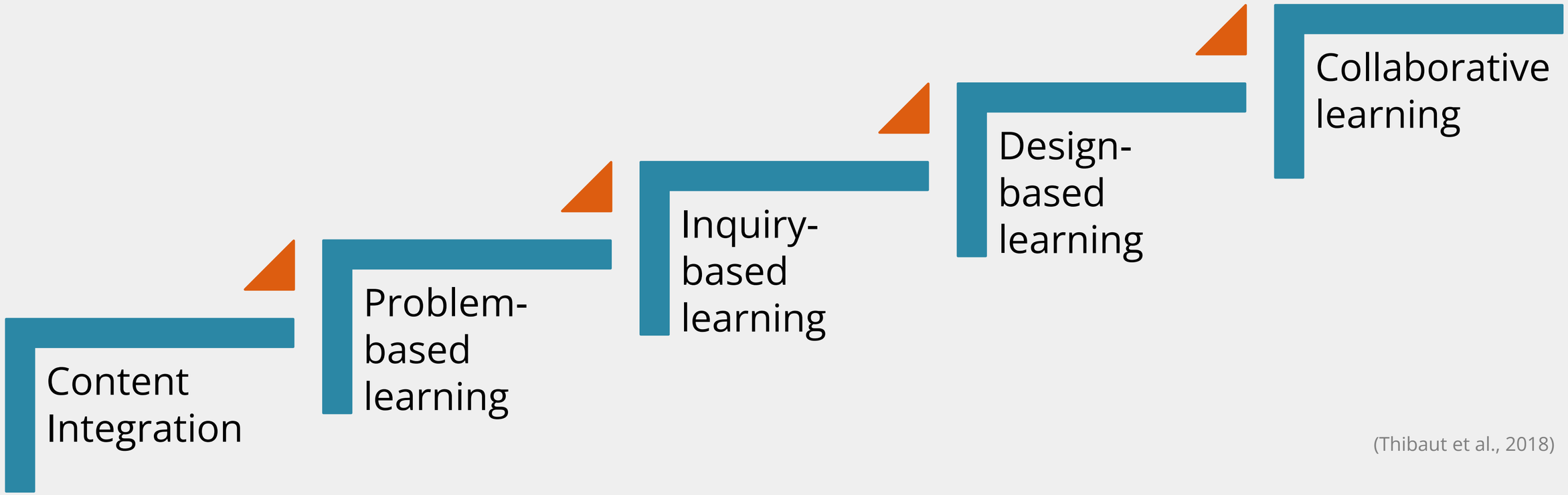
STEAM PBL



(Thibaut et al., 2018)

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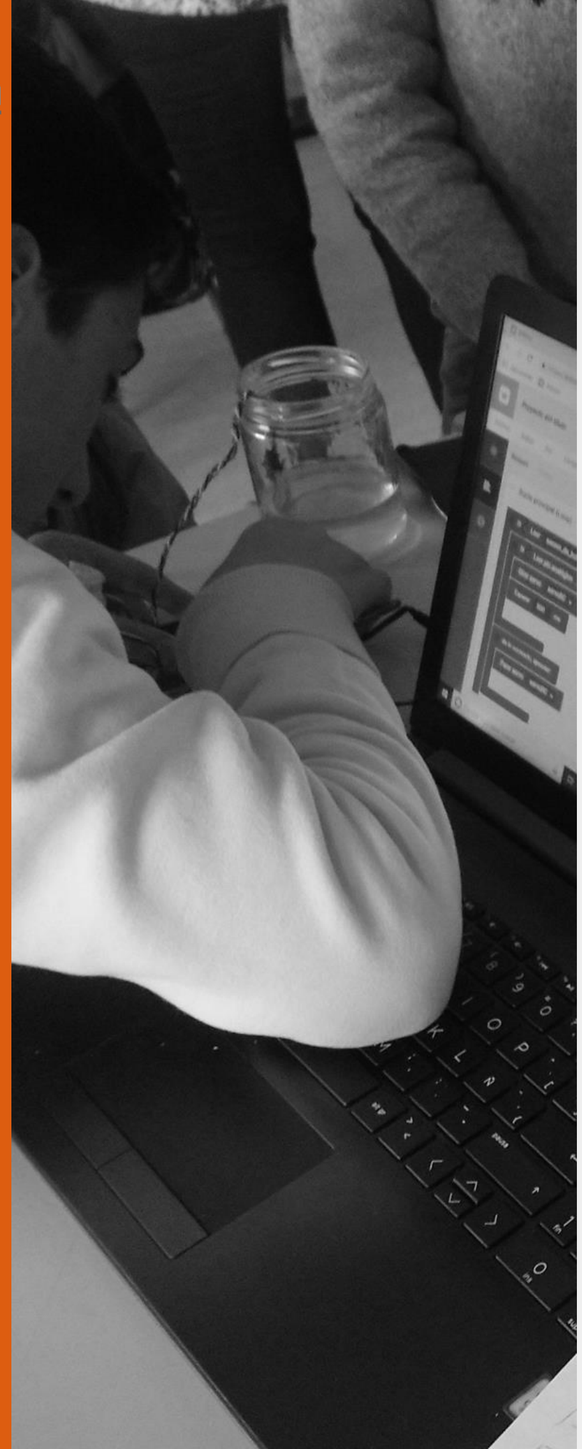

CONTENT INTEGRATION

Making connections between different disciplines

PERSPECTIVES

MULTIDISCIPLINARY — Concepts and skills are taught separately in each discipline, but within a common theme

INTERDISCIPLINARY — Concepts and skills are taught together to acquire in-depth knowledge

TRANSDISCIPLINARY — Knowledge and skills from different disciplines are applied to solve a real-world problem

(English, 2016)

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PROBLEM-BASED LEARNING

Students are required to solve real-world or realistic problems

These problems are usually ill-structured (having multiple solutions or no solution at all)

OBJECTIVES

- Applying knowledge in context
- Making the content more relevant
- Acquiring problem-solving skills

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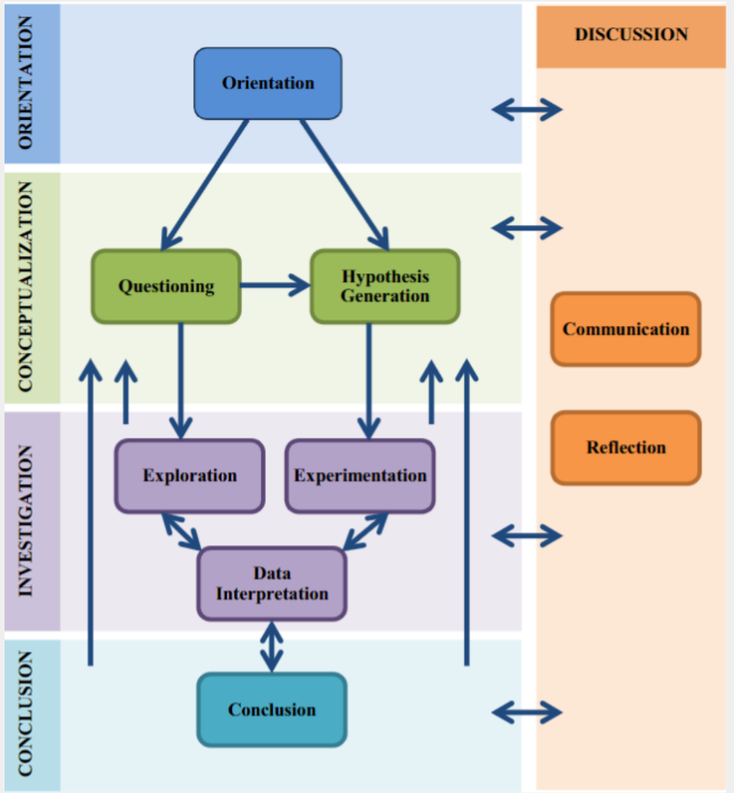
INQUIRY-BASED LEARNING

Students are introduced to mathematical and scientific ways of inquiry (Maas & Artigue, 2013)

PHASES OF THE INQUIRY CICLE



Different pathways

(Pedaste et al., 2015, p. 56)

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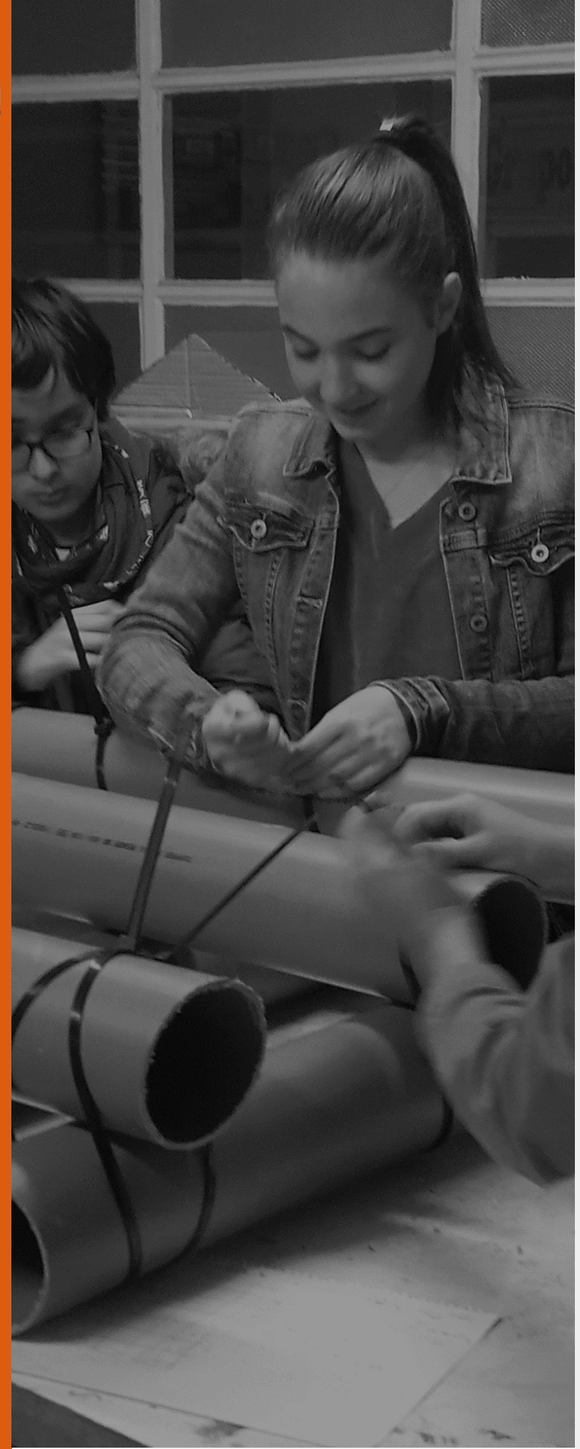
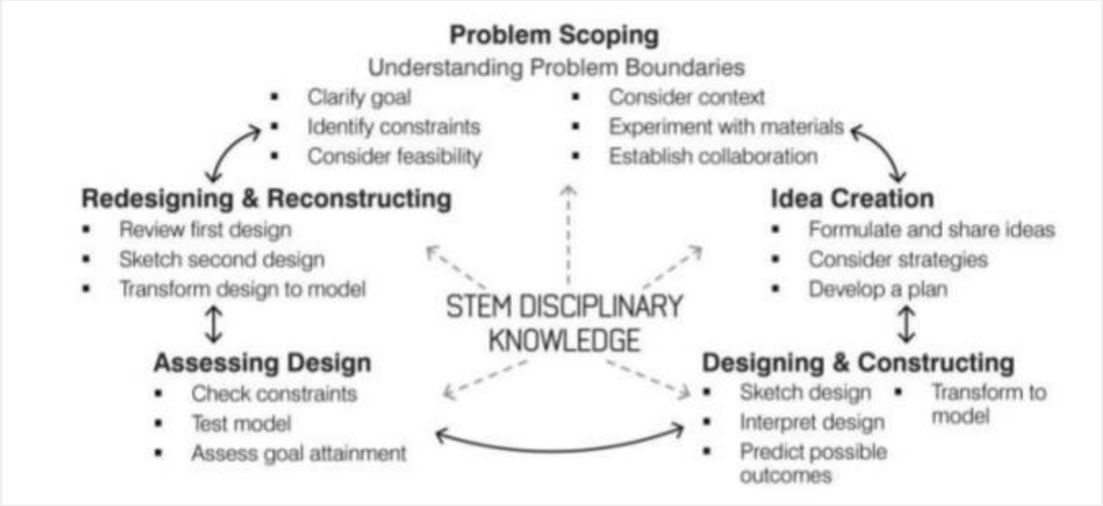


DESIGN-BASED LEARNING

Students are challenged to identify a problem, devise a solution strategy, design a product and evaluate it

DBL facilitates the incorporation of engineering and technology

ENGINEERING DESIGN PROCESS



(English et al., 2017, p. 256)

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COLLABORATIVE LEARNING

Students working together for achieving an objective

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PBL BENEFITS

Cognitive domain

Positive growth rate in students' mathematics and science achievement

(Acar et al., 2018; Han et al., 2015)

Affective domain

Motivation towards learning

Utility of mathematics

(Diego-Mantecón et al., 2019)

Key competences

Supporting life long learning

- Communication skills
- Teamwork skills

(Diego-Mantecón et al., 2021a; Özel, 2013)

To achieve these benefits, it is crucial a good project design and subsequent instruction (Diego-Mantecón et al., 2021b)

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RECOMMENDATIONS

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PROJECT DESIGN

Articulating curricular content to be addressed in the project

- Involving content from different disciplines in a natural way
- Searching for a context/topic to deal with the content and of interest for students (e.g., a concern in their surroundings)

Establishing collaborations with teachers from different disciplines

- Searching jointly for a context/topic to deal with the content and of interest for students
- Redefining the content to be exploited

Creating spaces and places to implement the project

- Reorganising the classroom (tables, chairs…)
- Setting lessons in other spaces (e.g., out-door, and computer and science laboratories) (Conner et al., 2017)

Making groups of 3-5 students

- Configurating the groups according to students' abilities and personal background

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Teachers act as facilitators of the learning process

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PROJECT IMPLEMENTATION

Promoting high cognitive demands

- Using questioning techniques (Jacques et al., 2020)
- Not focusing exclusively on the construction process (Diego-Mantecón et al., 2021c)

Equitable access to the content

- Using questioning techniques (Jacques et al., 2020)

Agency, Ownership, and Identity

- Including the design-based learning (Diego-Mantecón et al., 2019; Kijima et al., 2021)

Promoting formative assessment

- Assessment is an opportunity to learn, it is not only about quantifying
- Assessment must promote reflection
- Showing students how formative rubrics are used and explaining them that their aim is to “identify the areas for improvement rather than to evaluate their success or failure” (Capraro et al., 2013, p. 110)

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Many thanks!

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