

Designing an Agile and Sustainable Education Approach with Problem-Based Learning

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Outline

Introduction

Agile Methodologies

Agile Methodologies and sustainability

PBL, Agile and Sustainability

PBL Applications

Conclusions

Introduction

Challenges to education

Z- generation (1995/97 – 2010/12)



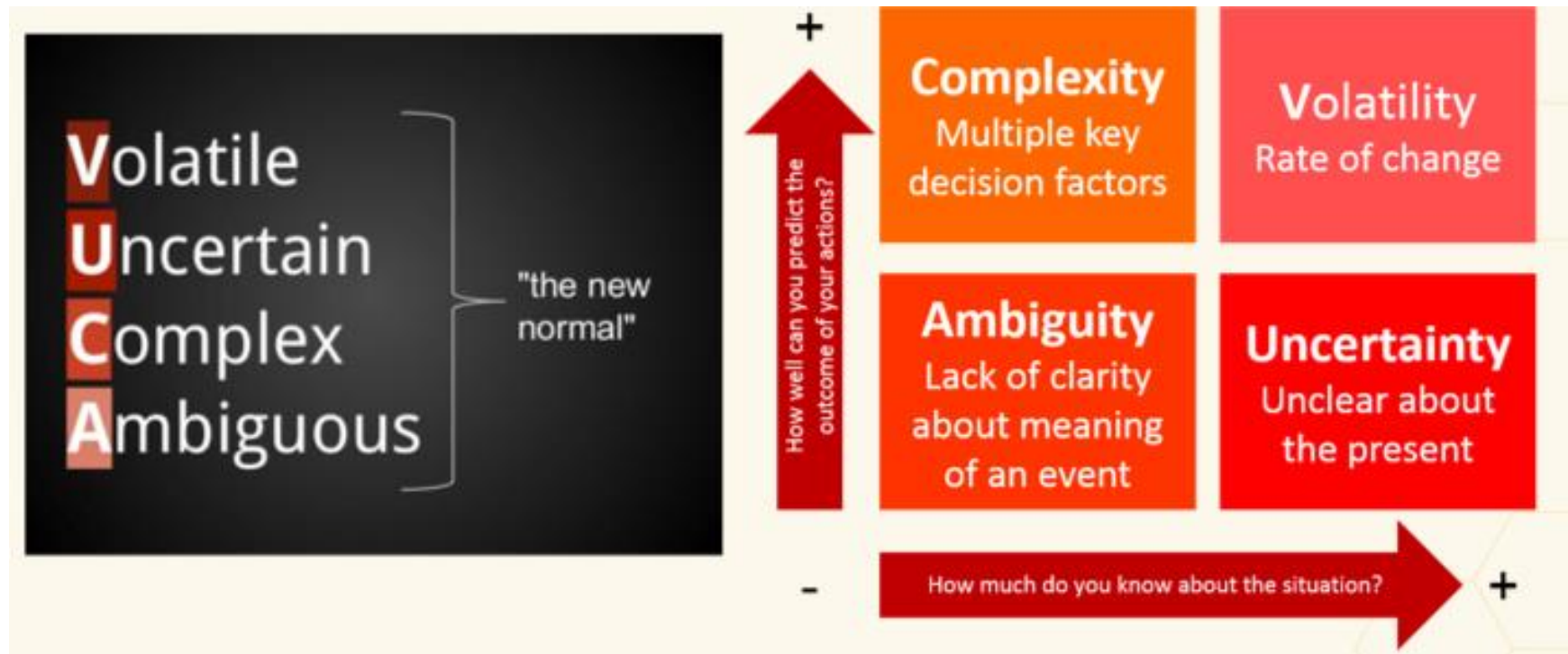
- Level of knowledge, skills and abilities in ICT
- Speed and efficiency of information retrieval
- Creation of contacts
- Immediate communication
- Exchange of information
- Analytical skills
- Ability to systematize
- Critically evaluate and use information



Aspects must be considered when planning the educational process

Labor market

VUCA world



Traditional education does not develop the skills necessary for practice.

[World Economic Forum Report, 2016]

Empowering Graduates

Integrating social and emotional learning (SEL) for enhanced employability and professional growth.

SEL

```
graph TD; SEL --> CQ[Character qualities]; SEL --> S[Skills];
```

[Póscova, J. et al., 2020]

Character qualities:

curiosity, initiative, persistence, passion perseverance, adaptability, leadership, social and cultural awareness

Skills:

critical thinking, problem solving, creativity, communication, collaboration

Empowering Graduates


Soft skills are as important as hard skills for the successful integration of graduates into industrial practice.

Over the years, educators have been striving to introduce **new methodologies** and approaches into their classes in order to meet the demands of the labour market and the needs of new generations.

Active learning methodologies have proved to be more effective in developing hard and soft skills.

**Agile
methodologies**

Agile Methodologies

- Project management approach that prioritizes cross-functional collaboration and continuous improvement.
- Originally used in the software sector to keep up with the quickly changing technical landscape.
- Divides projects into smaller phases and guides teams through cycles of planning, execution, and evaluation.
- Strong emphasis on flexibility, teamwork, cooperation, and continuous adaptation  Teams respond rapidly to changing needs and produce high-quality products.

Agile - ability to move quickly and easily

Agile

Ability to move **quickly and easily**.

Iterative and team-based approach, attempting to **reduce the waste of resources, development time and effort**.

Adaptive development by means of **short continuous cycles of planning, action, correction and adjustment** to produce valuable increments in outcomes.

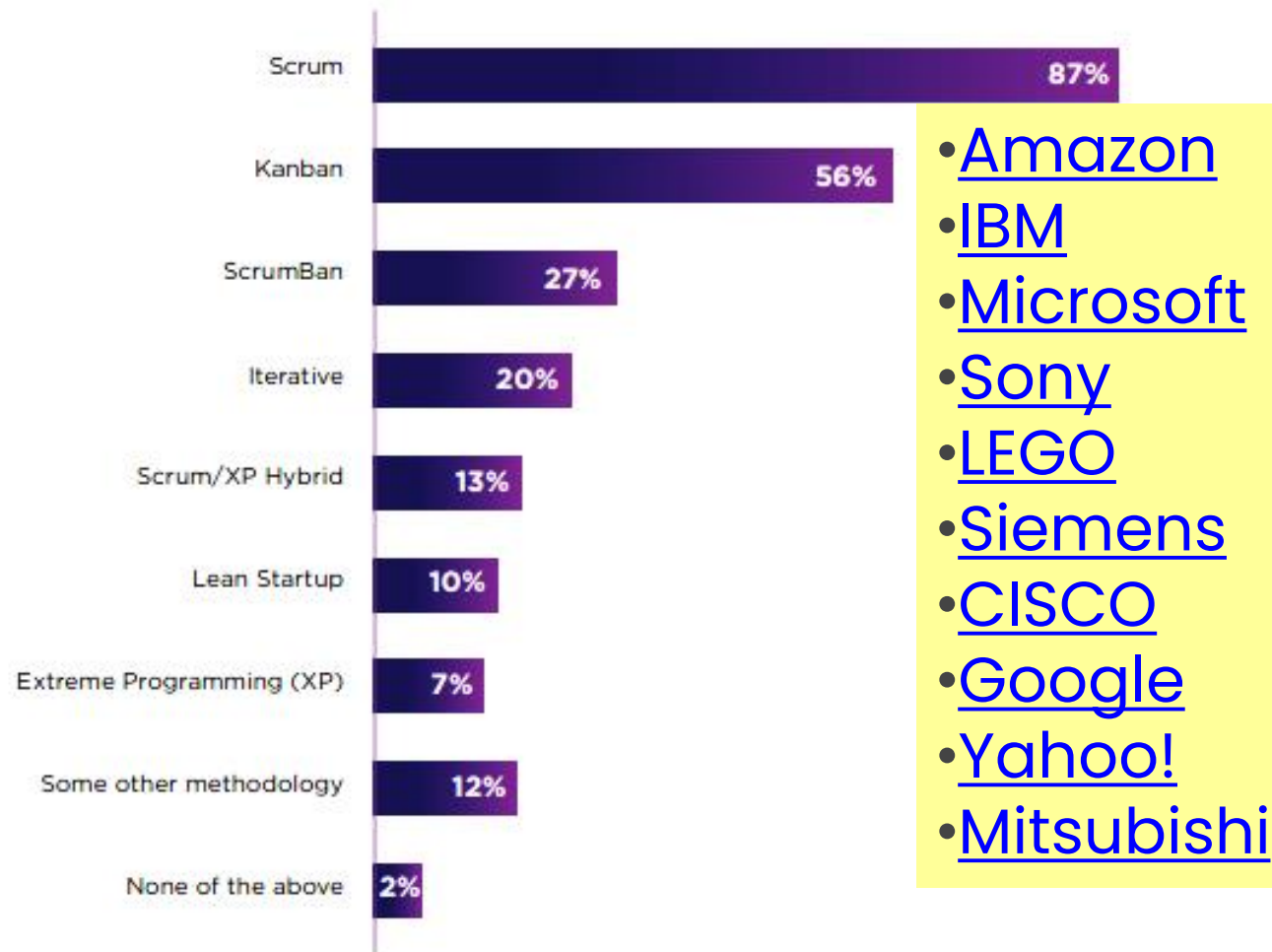
Agile Methodologies

- Scrum
- Kanban
- eXtreme Programming (XP)
- Crystal
- Dynamic Systems Development Method (DSDM)
- Feature Driven Development (FDD)
- ...

More emphasis on people, focusing on the **talents** and the **skills**.

Agile, an approach used by the most innovative companies

(16th annual State of Agile report, 2022.
<https://info.digital.ai/rs/981-LQX-968/images/SOA16.pdf>)



- [Amazon](#)
- [IBM](#)
- [Microsoft](#)
- [Sony](#)
- [LEGO](#)
- [Siemens](#)
- [CISCO](#)
- [Google](#)
- [Yahoo!](#)
- [Mitsubishi](#)

Increasing productivity and client satisfaction.

Agile in education

- Can better equip students with the necessary skills to succeed in today's dynamic job market.
- Promotes critical thinking, problem-solving, and teamwork.
- Future citizens are well-prepared to face the challenges that an ever-changing society may bring.
- First introduced in software engineering courses.
- Also effective in teaching other subjects.
- Emphasizes adaptability and responsiveness in the learning process.
- Promotes iterative and collaborative learning, allowing students to constantly refine their understanding and skills.

Traditional/Agile education

Source: López-Alcarria et al., 2019

Element	Traditional	Agile
Syllabus	Over specified, rigid,...	Open to modification to adjust it to students' motivations
Schedule	Difficulty to allocate extra time when needed	Not directly associated to syllabus in a rigid way.
Roles	Teacher: Knowledge Students: Passive	Teacher: Facilitator Students: Active, autonomous,...
Communication	Reduced	Encouraged
Education theory	Behavioral theory	Constructivist theory
Class structure	High hierarchical	Flat hierarchy
Assessment	Assessment of students performance	Continuous assessment

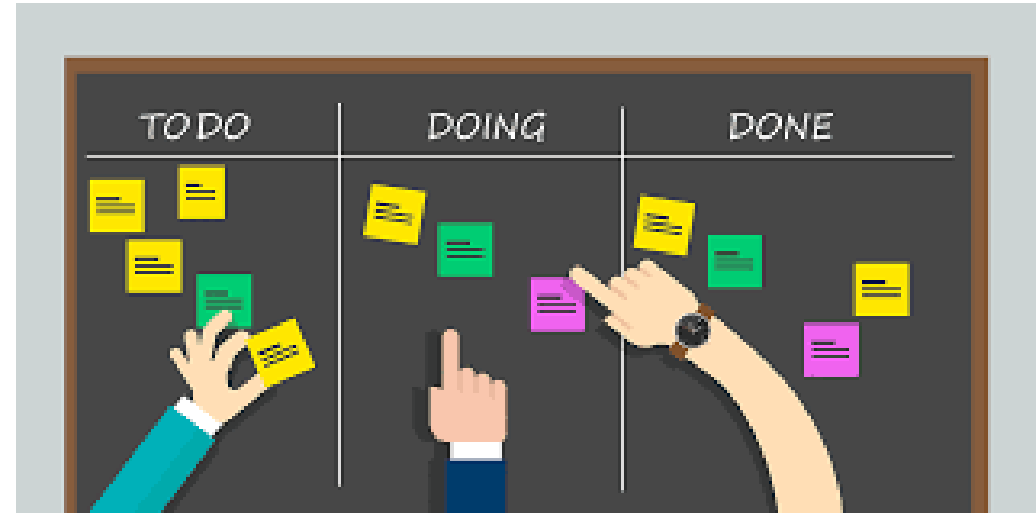
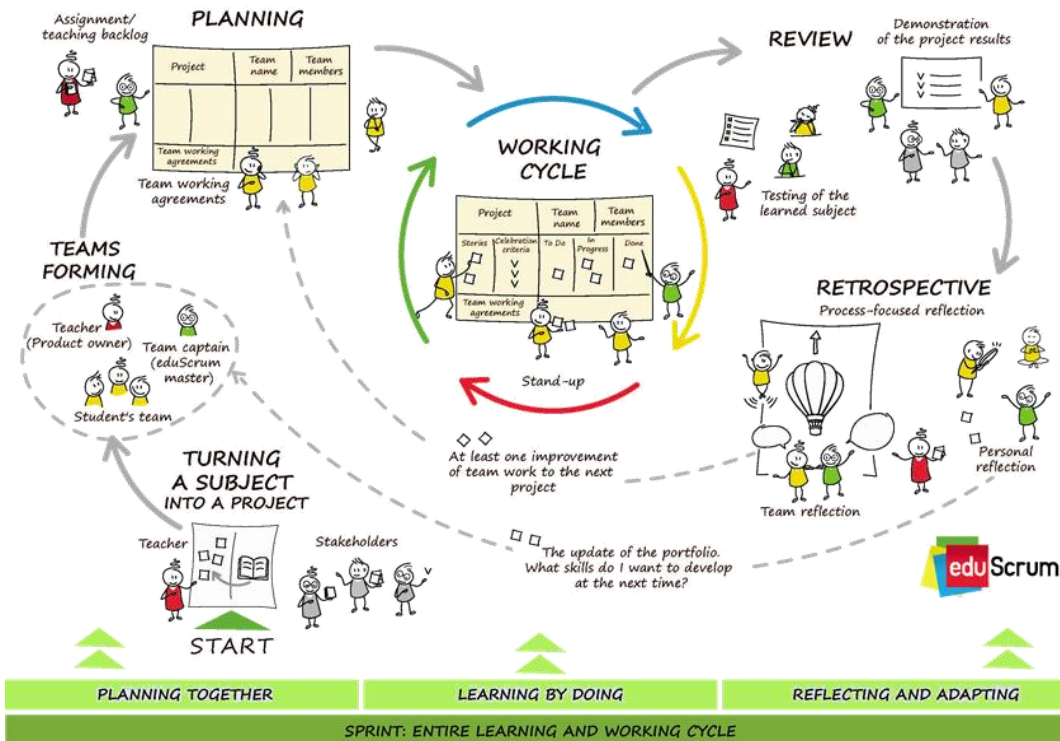
Agile Methodologies – Students' competencies

- Comprehension
- Critical thinking
- Reflection
- Reconstruction of knowledge
- Collaboration
- Search, analysis and synthesis of information
- Active problem solving
- Self-regulation of learning
- Open-mindedness to others' ideas. Identification of strengths of team members
- Learning to learn, building effective knowledge and mental models
- Creative problem solving

Agile Methodologies - examples

EduScrum

How eduScrum works



Kanban

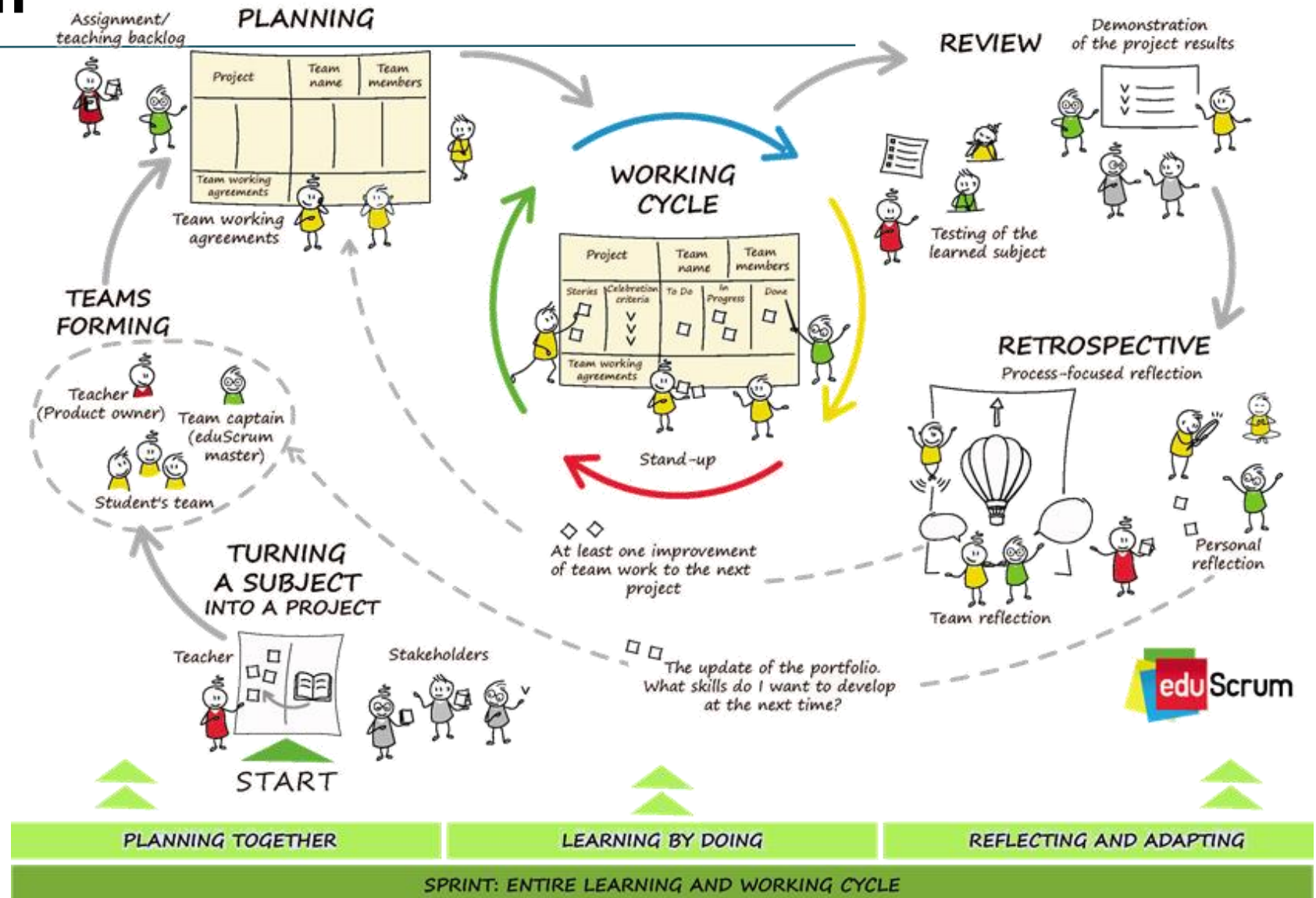
Kanban features

- **Visualization:** Kanban boards help visualize different stages of the workflow
- **Efficiency:** Kanban enables teams to optimize work delivery across multiple teams and handle complex projects in a single environment. It maximizes efficiency by providing real-time visibility into the state of every piece of work .
- **Work in Progress (WIP) Limits :** Kanban empowers teams to become more efficient by setting Work in Progress (WIP) limits. These limits prevent teams from taking on excessive work and help maintain focus and quality.
- **Evolutionary Approach:** It allows teams to improve continuously without disrupting the current processes. It provides an evolutionary path towards agility .



EduScrum

How eduScrum works



Source: <https://thinkingwithyou.com/2023/02/eduscrum/>

Sustainable Education Approach



The Sustainable Development Goals (SDGs) were established in 2015 by the United Nations and aim to **end poverty, protect the planet** and ensure that by 2030 **all people can enjoy a dignified life**, where **no-one is left behind**.


The Five Ps' model of Sustainable Development



The role of education

- Education enables upward socio-economic mobility and is a key to escaping poverty.
- Education helps to reduce inequalities and achieve gender equality
- Education is crucial for promoting tolerance and more peaceful societies.
- Education is the key process for generating sustainable and responsible citizens and prepare them for the labor market but is also affected by new challenges from our ever-changing society.

Educational Sustainable Development (ESD) and Agile

- Educational approaches that promote sustainable development principles and practices.
- It aims to equip learners with the knowledge, skills, and attitudes necessary to understand and address sustainability challenges.
- ESD focuses on creating an environmentally conscious and socially responsible learning environment, promoting values of sustainability in students, promoting a deep understanding of the interconnectedness between humans, the environment, and society.
- Emphasizes the importance of promoting sustainable practices - waste reduction, energy conservation, and responsible consumption  **Agile principles**

Agile Methodologies and sustainability

Inclusivity

Valuing diversity,
environment,
justice

Knowledge of
interconnected
ecological, social,
economic systems

Knowledge of the
principles of
sustainable
development

Holistic or systemic
thinking and
analysis

Knowledge of
sustainability
issues and
problems

Working across
disciplines

Cooperative action
and conflict
resolution

Dealing with
uncertainty

Taking action to
bring change

Mediating and
resolving conflicts

PBL

One of the key challenges for Education for Sustainable Development (ESD) is to define **pedagogies** and **methods** that permit the development of competencies in a transversal and **holistic** way and allow sustainability to expand out of teaching scenarios beyond the nature sciences and environmental issues.



Problem-Based Learning (PBL) is an educational approach that centers around solving real-world problems. It encourages students to actively engage in solving complex problems, promoting critical thinking, collaboration, and the application of knowledge in practical scenarios.

PBL – students role



Students have to

- conduct research
- learn new information
- integrate theory and practice
- apply knowledge and skills
- find solutions to the problem at hand

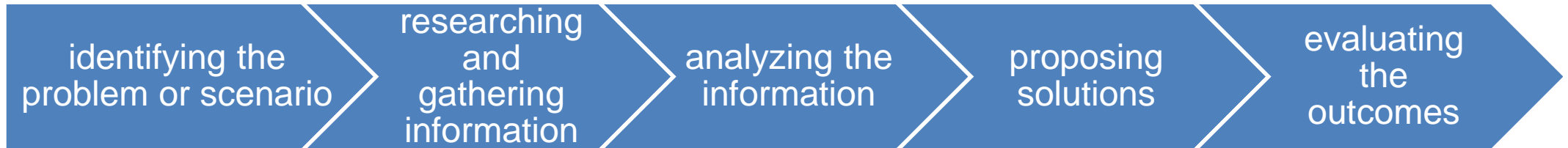
PBL – teacher role



- facilitator
- inquiry by asking open-ended questions
- exploration of potential answers
- encourage different approaches



PBL



PBL

- PBL contributes to sustainability in education by encouraging students to explore and analyze complex problems that are relevant to their community and the world.
- By focusing on real-world problems, problem-based learning also fosters a sense of urgency and responsibility in students to find innovative and sustainable solutions.
- PBL equips students with the knowledge and skills needed to address current challenges but also prepares them to tackle future issues in a sustainable and ethical manner.
- PBL fosters creativity and innovation as students are encouraged to think outside the box and come up with unique solutions.

PBL applications

Differential and integral Calculus- CALCL

1st year - 1st semester

- Case-studies proposed on a PBL model
 - application of differential and integral calculus to solve real world problems
 - epidemic outbreaks
 - analyzing data from rainfall in certain areas of the globe

Statistical Models – SM

2nd year – 2nd semester

- Case-studies proposed on a PBL model
 - Real world applications of statistical methods

PBL applications

Differential and integral Calculus - CALCL

1st year - 1st semester

The PBL problem solutions:

- using *PolleEv*, *Kahoot*, *EclipseCrossword*
- Poster
- Leaflets on climate change

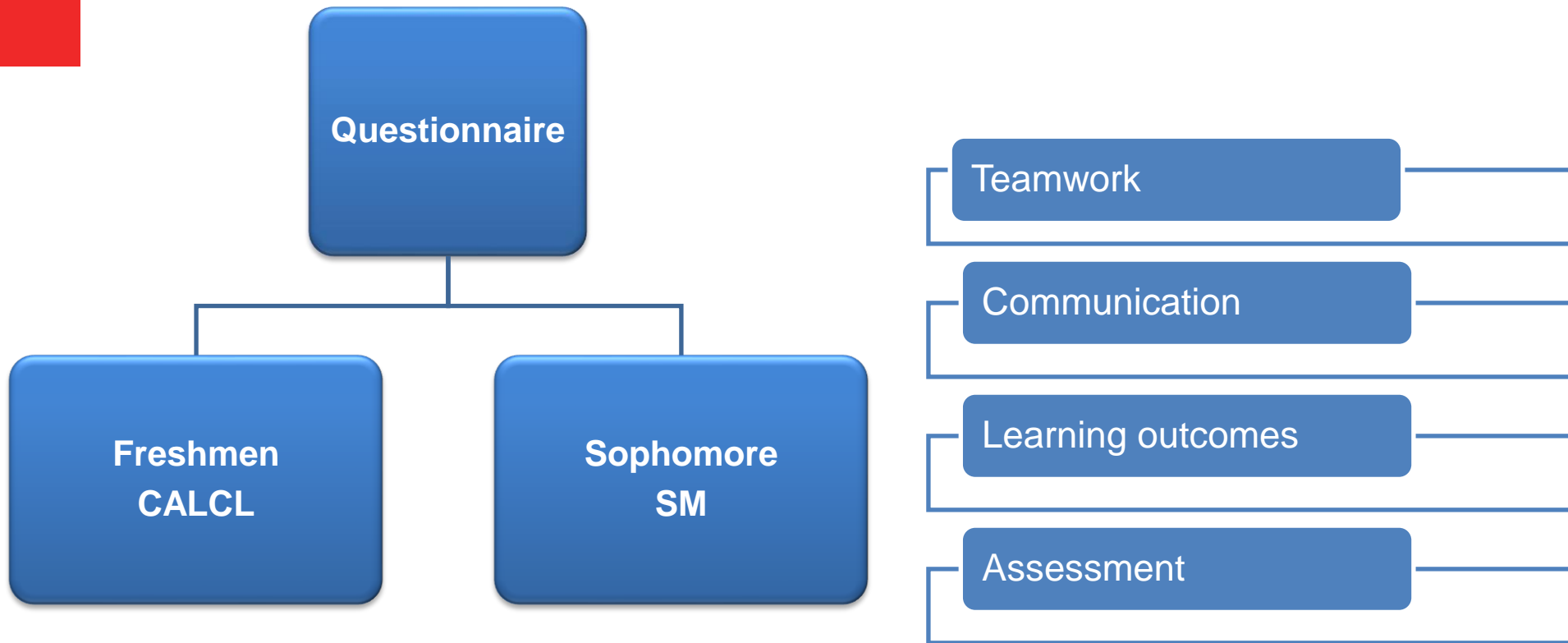
Statistical Models – SM

2nd year – 2nd semester

The PBL problem solutions:

- “Selling” the solution
- Written report
- Scientific poster

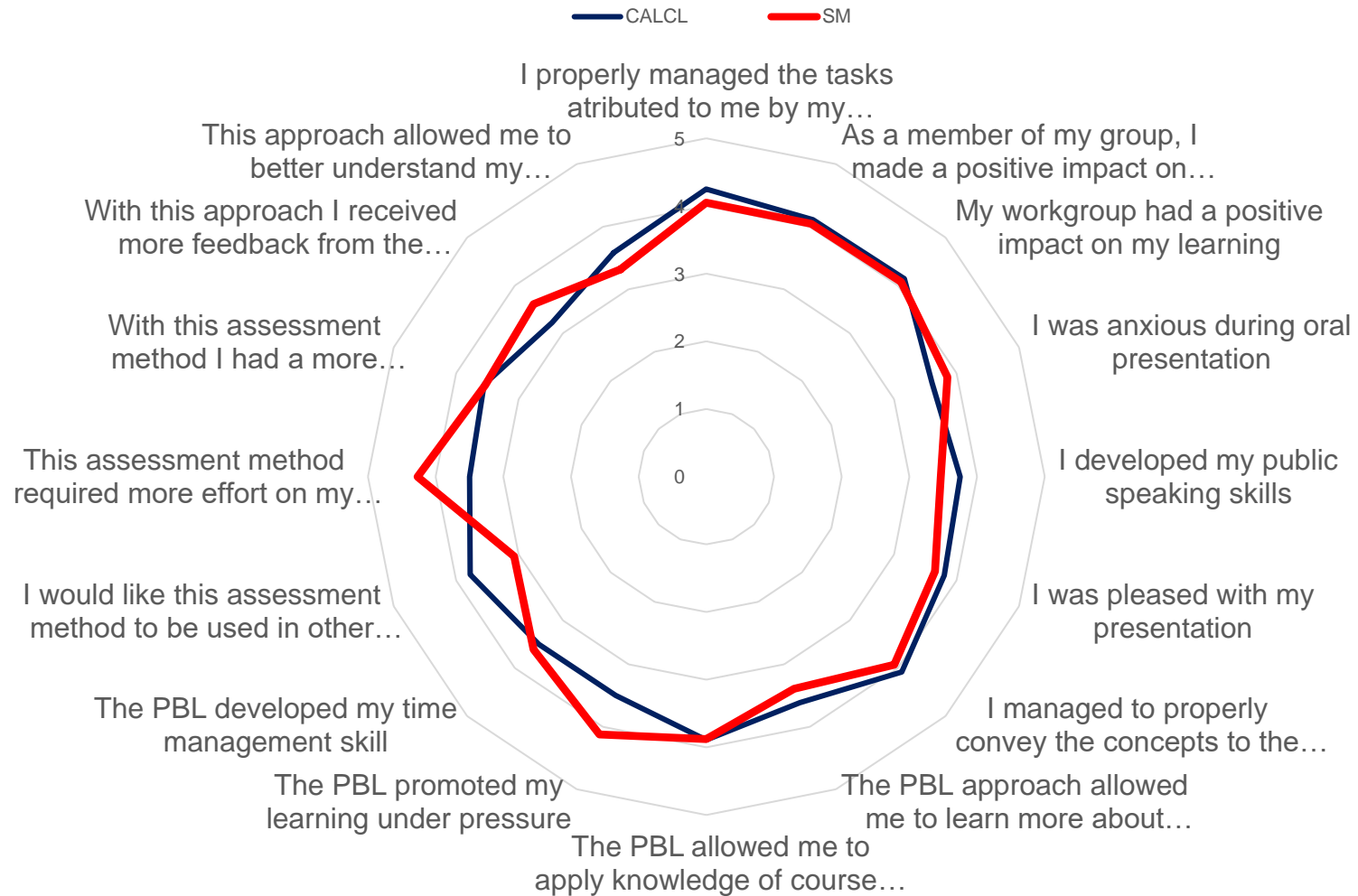
PBL applications



PBL applications

	CALCL		SM		U M-Whit	Sig.
	Mean	SD	Mean	SD		
The PBL promoted my learning under pressure	3,50	0,97	4,12	0,84	481,5	0,006
I would like this assessment method to be used in other Curricular Units	3,78	1,05	3,07	0,88	429	<,001
This assessment method required more effort on my part	3,50	1,00	4,27	0,55	407,5	<,001

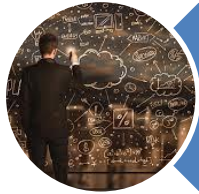
PBL applications



PBL applications



How do students perceive their skill levels on teamwork and communication?



How do students perceive their knowledge acquisition?



How do students perceive the assessment methods?



Are there differences in the views of freshman and sophomore students regarding the PBL experience?

CONCLUSIONS

- The majority of participants felt positively about their learning experience
- Knowledge acquisition more effective
- Developing of critical thinking, communication, and collaboration
- Assessment methods more engaging
- Learning application directly in real-life scenarios
- PBL can benefit students' academic growth by providing opportunities for active engagement
- PBL helps to engage different learners in mathematics classrooms
- Teachers gain more insights into what works best and where improvements should be made in their classes
- Students achieve higher academic goals and better preparation to cope with the rapidly changing labour market.

Thank you!
Muchas gracias!
Obrigado!

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