STEAME

TEACHER FACILITATORS ACADEMY

D2.2 STEAME TEACHER FACILITATORS LEARNING OUTCOMES SET

STEAME TEACHER ACADEMY

Project's Reference number: 101102619

Co-funded by the European Union

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WP2

D2.2. STEAME Teacher Facilitators Learning Outcomes set

Deliverable leading partner: University of Barcelona

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1. INTRODUCTION

The present deliverable accounts for the STEAME Teacher Facilitators Academy project task T2.2 Determination of the Learning Outcomes. This task has been led by partner P9 (University of Barcelona), with the support of P7 (IDEA) and P14 (DOUKAS School) as co-leaders. All partners contributed to this task.

This task builds on the results of task T2.1 Preparation of Definitions and filtering of results from the selection of 16 feedback projects. This task aimed to gaining an understanding of the work previously done in Europe towards the theoretical and practical operationalisation of Project-Based Learning approaches in STEAME subjects. According to the project proposal, this task would include the review of other projects not considered during the writing of the proposal. Accordingly, task T2.1 eventually consisted in a comprehensive analysis of 24 previous STEAME projects, as reported in deliverable D2.1 Comparative Report analysis of the 16+ projects.

The analysis of previous projects consisted of applying a specifically designed tool that allowed to collect relevant information in three main dimensions, namely 1) Technical and contextual information about the projects, 2) Information relevant to the creation of a teaching competence framework, and 3) Information relevant to the operationalization of key constructs of this project, I.e. STEAME and Project-Based Learning (PBL). As reported in deliverable D2.1, the analysis yielded several results that can be summarised as follows:

- Most projects are aimed at service teachers and include proposals to be applied at a classroom level.
- Not many projects contemplate the transfer between school and academic world and the world of work.
- Most projects include materials to apply a teaching concept, methodology or approach to facilitate its implementation and reproduction in other contexts or to facilitate their application by different target groups.
- Only 7 of the 24 projects consider social responsibility and ethical commitment (gender equality and non-discrimination between men and women) and sustainable practices.
- Among the projects that include a competence framework, they generally state the problems they want to solve, but most of them don't consider the multi-level nature of these problems (individual, school community, professional networks).
- The projects offering competence frameworks have a forward-looking educational purpose based on digital citizenship and sustainability and are aimed to teachers more than to students.
- The projects incorporate interdisciplinarity, by integrating different subjects or areas of knowledge, specifically from a STEAME point of view.
- The projects that promote PBL seem to operationalize it as service learning. In this way, the approach intends that the project developed at school has a contribution or a return to society.
- In most cases the project application or its impact is considered from a cross-country perspective.

Building on this basis, task T2.2 consisted of merging, structuring and elaborating these results into a conceptual mapping, deriving the required learning outcomes that will serve as a basis to design modules and workshops in WP3. According to the literature, learning outcomes are defined in this project as "statements of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning" (Adam, 2006, p. 2). They are "concrete and verifiable signs that witness/certify how the planned competences, including the required levels of knowledge, are being developed or acquired" (Lokhoff et al., 2010).

The present document starts by accounting for the process that was carried out to accomplish task T2.2. Then, the results of this task are presented, i.e. the set of learning outcomes separated for service teachers and student teachers. Last, conclusions and further steps in this Work Package are provided.

This document will become part of the Competence Framework so its translation in the project languages will appear in the Competence Framework.

2. PROCESS TO DETERMINE THE LEARNING OUTCOMES

As stated earlier, the results from deliverable D2.1 have been taken a step forward. This process consisted of three steps, namely:

1. Grouping the results of deliverable D2.1
2. Further inquiry of selected results of deliverable D2.1
3. Establishing premises for the learning outcomes
4. Determine and apply learning outcomes formulation criteria

What follows is a detailed description of each of these steps.

2.1. Step 1: Grouping the results of deliverable D2.1

The first step to accomplish this task was to sort the results of deliverable D2.1 in three groups, namely: 1) Results that confirm the intentions and premises of the STEAME Teacher Facilitators Academy project; 2) Results that become direct inspiration for the learning outcomes of the STEAME Teacher Facilitators competence framework; and 3) Results that need further inquiry.

Two results belong to the first group, to the extent that they confirm the intentions and premises of the STEAME Teacher Facilitators Academy project. These results are: "Most projects are aimed at service teachers and include proposals to be applied at a classroom level"; and "Most projects include materials to apply a teaching concept, methodology or approach to facilitate its implementation and reproduction in other contexts or to facilitate their application by different target groups".

As per the first result, two observations can be made. Regarding the point about aiming at service teachers, although the STEAME Teacher Facilitators Academy project focusses both on student teachers and service teachers, the competences for student teachers must be based on those of serving teachers, not only because student teachers may in many cases be current teachers undertaking formal education to obtain a qualification, but because one of the aims of competence frameworks is to contribute to conceiving the teaching profession as a continuum that spans from their education to the end of their career. Concerning the fact that the projects include proposals to act at a classroom level, this is a shared principle of the STEAME Teachers Facilitators Academy project.

By focussing on PBL applied to STEAME, which is a teaching approach, the project aims to introducing innovations in classroom practice that have an impact on students' learning experiences.

As per the second result, we consider that it confirms the premises of the STEAME Teacher Facilitators Academy project because the project has a practical approach where both student and service teachers think of ways to apply this methodology in their practice.

As mentioned earlier, the results included in the second group become premises or direct inspiration for the learning outcomes of the STEAME Teacher Facilitators competence framework. These results are:

- "The projects (…) have a forward-looking educational purpose based on digital citizenship and sustainability and are aimed to teachers more than to students"
- "The projects incorporate interdisciplinarity, by integrating different subjects or areas of knowledge, specifically from a STEAME point of view"
- "The projects that promote PBL seem to operationalize it as service learning. In this way, the approach intends that the project developed at school has a contribution or a return to society"
- "In most cases the project application or its impact is considered from a cross-country perspective".

The third group of results is made of those that needed further inquiry, as they have potential to provide valuable information for determining the STEAME learning outcomes. These are the following:

- "Not many projects contemplate the transfer between school and academic world and the world of work"
- "Only 7 of the 24 projects consider social responsibility and ethical commitment (gender equality and non-discrimination between men and women)"
- "Among the projects that include a competence framework, they generally state the problems they want to solve, but most of them don't consider the multi-level nature of these problems (individual, school community, professional networks)".

2.2. Step 2: Further inquiry of selected results of deliverable D2.1

The second step in the conceptual mapping of the results of deliverable D2.1 was to further inquiry about the results from the third group. To that goal, we focussed on projects that were selected in deliverable D2.1 as the closest in terms of content to the STEAME Teacher Facilitators Academy project. These are the following:

1. STEAME goes Hybrid https://www.steame-hybrid.eu/
2. ONLIFE https://onlife.up.krakow.pl/
3. L-Cloud https://www.l-cloud.eu/en_US/
4. ETRe https://etre-project.eu/
5. Facilitate-AI https://facilitate-ai.eu/
6. TOGETHER https://together-erasmus.eu/

In formal terms, we found out that all the competence frameworks proposed in these projects, except for that from the L-Cloud project, include at least two levels of hierarchy. The first level is a group of competences that share a common meaning, and the second level is the competences themselves (see figures 1 and 2 below). For this reason, we analysed the competence frameworks of these projects at two levels, namely: 1) competence area level; 1) competence level.

CATEGORIES	COMPETENCIES
1. PEDAGOGY (P)	
Related to using appropriate teaching and learning methodologies adapted to hybrid learning situations, (digital/online teaching), and to all students (different ages and abilities)	Knowledge about teaching strategies as problem-solving, PBL, gamification, or flipped classroom (among other), adapted to hybrid learning (K)
	Ability to integrate digital communication with students/teachers/parents (S)
	Abilities to look at problems and find solutions using co-creation approaches (S)
	Commitment to foster inclusion, and equal opportunity in today's complex education by identifying and adopting different approaches for teaching students of different ages and levels (D)

Figure 1: Excerpt from the ONLIFE project competence framework showing the two levels of hierarchy, namely categories and competencies

Figure 2: Excerpt from the ETRe project competence framework showing its two levels of hierarchy: four big areas, and the competences inside them

Mapping at a competence area level

The “STEAME goes hybrid” project, which is concerned with designing and developing STEAME Schools, defines STEAME competences for teachers who want to teach in this way, as structured in the following competence areas:

- Soft skills
- Digital skills
- Creativity skills
- Innovation skills
- Leadership skills
- Communication skills
- Management and organizational skills
- Collaboration skills
- Problem solving skills
- Critical thinking skills
- Ethical
- STEAME skills
- Cyber security and safety skills

The “ONLIFE” project, which developed a methodology to support the life adaptability of teachers in the online teaching process in School Education so they can have hybrid competences as teachers, defines four categories of competences:

- Leadership
- Pedagogy
- Technology
- Metacognition

The “ETRe” project, which focused on Empowering schools’ transition readiness to a distance/hybrid learning model enhanced by cloud technology tools, organises the educators’ competences in four groups:

- Professional skills
- Soft skills
- Digital skills
- Teaching skills

The “Facilitate AI” project, which is still running at the time of writing this report, organises teachers’ competences for facilitating learning of Artificial Intelligence (AI) by School Students of Grades 7-12 in five areas:

- Teaching & Learning (Strategies, Empowering Learners, Assessment)
- Information & Digital Literacy (Digital Sources, Digital Creation, Coding)
- Communication & Collaboration (Motivation, Teamwork, Sharing, Promoting)
- Creation & Innovation (Problem Solving, Creative Thinking, Reasoning)
- Emotion & Ethics (Attitudes-Values, Social Emotional Skills, Privacy)

Finally, the "TOGETHER" project created a competence framework for teachers who wish to foster digital creativity of young generations by using the "service learning" methodology. The framework is divided between hard and soft skills. As part of the hard skills, two groups of competencies can be found, namely 1) Humanities, and 2) ICT. In turn, three groups of competence compose the soft skills part, namely 1) soft skills themselves, and 2) Entrepreneurial skills.

As a result of comparing the competence areas proposed in these projects, we discovered that in quantitative terms, most frameworks include between four and six areas or groups of competencies. Only the STEAME Hybrid project has a longer list of competence areas. Moreover, by merging the competence areas from all these projects, four common areas can be identified. At this point of the process of building the STEAME Teachers Facilitators competence framework, these **four big areas** can be named as follows:

1. **Soft skills:** related to communication, collaboration, and organisation
2. **Teaching skills:** related to teachers' task to help students learn, STEAME content knowledge, etc.
3. **Professional skills:** related to teachers' being committed to the continuing improvement of formal education by exercising critical reflection, innovation, and applying creativity
4. **Digital skills / technology:** related to productively using technologies to facilitate learning in face-to-face or hybrid teaching and learning contexts, as well as the ability to manage digital identity and cyber safety issues that may arise as part of students' working online.

Mapping at a competences level

As stated earlier in this section, the second level of hierarchy of the competence frameworks found in the projects is competences themselves. At this level, we classified the competences from all projects in the four big areas identified above (see table 1 below). In this way we aim to check to what extent these emerging competence areas accurately represent the contents of the competence frameworks selected. Results are presented below, where the project to which each competence belongs is in brackets.

Competence area 1: soft skills
Teaching competences (STEAME Hybrid)
Planning, organisation, and decision-making skills (ONLIFE)
Promote resilience and self-confidence in yourself and in the organisation (ONLIFE)
Communication, information, collaboration, innovation, problem-solving (ETRe)
Social and intercultural relationship and internalization (L-Cloud)
Communication and collaboration (TOGETHER)
Competence area 2: teaching skills
Developing inquiry-based and creative approaches (STEAME Hybrid)
Math and science subject-related and integrated competencies (STEAME Hybrid)
Engineering (STEAME Hybrid)

Manifesting empathy toward students, commitment to teaching, flexibility in approaches, and leadership (STEAME Hybrid) Knowledge about teaching strategies, Problem-solving, PBL, Gamification, flipped classroom, adapted to hybrid learning (ONLIFE) Commitment to foster inclusion, cross-cultural skills and equal opportunity in today's complex education (ONLIFE) Creation/adaptation/distribution of learning resources to digital formats (ONLIFE) Teaching and learning, empowering learners, knowledge construction, assessment (ETRe) Pedagogical and Organizational (L-Cloud) Acquiring specific transferable achievements, adapting accessibility and inclusion, adapting differentiation and personalisation, adopting new methods of teaching and learning, creatively using digital technology, eliminating disadvantages, enhancing the effectiveness of teaching, ensure continuous professional development, identifying needs and technological responses, interacting through digital technologies, using assessment strategies, providing feedback to learners (Facilitate AI) Self-regulated learning, enhancing the activities for learning, actively engaging learners, implementing learning plans (Facilitate AI) Use suitable methodologies (TOGETHER) Pedagogical competencies (TOGETHER) Guidance competences (TOGETHER)
Competence area 3: professional skills
Critical thinking (STEAME Hybrid) Ability to integrate digital communication with students/teachers/parents (ONLIFE) Abilities to look at problems and find solutions using co-creation approaches (ONLIFE) Disposition to lifelong learning (ONLIFE) Willingness to participate in a learning community at the school level or at the national/international level (ONLIFE) Professional Development (L-Cloud) Leadership, ethics and responsibility (L-Cloud) Critical thinking and analysis (TOGETHER) Demonstrate civic responsibility (TOGETHER) Languages (TOGETHER)
Competence area 4: digital skills / technology
Ability to establish an understanding in the professional community of the pervasiveness of digital solutions in everyday life and in teaching profession (ONLIFE)

Disposition to motivating, encouraging, trusting and valuing colleagues to explore digital approaches for both disruptive and regular situations (ONLIFE)
Ability to organise online/hybrid learning environments using adequate digital tools (ONLIFE)
Ability to managing, protecting and sharing educational resources in hybrid environments (ONLIFE)
Knowledge of different cloud education solutions to schoolwork (ONLIFE)
Disposition to critical thinking on the promises of digital technologies for the transformation of schools (ONLIFE)
To be open to fast technological change, and qualify as problem solver (ONLIFE)
Digital use, digital content, digital emotional intelligence, digital literacy, digital identity, digital rights (ETRe)
Knowledge and ability to set up a cloud learning environment (L-Cloud)
Ability to creatively use cloud education environments in different educational contexts (L-Cloud)
Information and data literacy (TOGETHER)
Browsing, searching and filtering data, information and digital content (TOGETHER)

Table 1: Mapping of selected projects competences into the four competence areas identified

As a result of organising the competences from the six projects into areas, we found answers to the results that needed further inquiry that were mentioned before, as shown in table 2.

Results that needed further inquiry	**Results of the inquiry**
Not many projects contemplate the transfer between school and academic world and the world of work.	There is a strong focus on cooperation between schools and industry. This could be linked with the Entrepreneurial aspect of the project.
Only 7 of the 24 projects consider social responsibility and ethical commitment (gender equality and non-discrimination between men and women).	Because of the topic of the projects or the time in which they took place, they are very technology-focused (hybrid education, Artificial Intelligence...). As a result, the idea of responsibility is applied to teachers' management of students' personal data, content contributions and behavior on the internet.
Among the projects that include a competence framework, they generally state the problems they want to solve, but most of them don't consider the multi-level nature of these problems (individual, school community, professional networks).	Breaking the boundaries of the classroom is a core aspect of Project-Based Learning, and teachers need skills to do it successfully, including collaboration with other teachers and aspects concerning school organisation.

Table 2: Answers obtained to results that needed further inquiry

As a result of the inquiry, we also found out that:

1. Disciplinary content / knowledge is not so represented in these frameworks. We can state that they are more "methodological" or focus on teachers' pedagogical knowledge, as opposed to subject matter knowledge.
2. Because some projects had a longer or more detailed list of competences, they may have been overly represented in this analysis than others. It is important to add our own views about what STEAME education is.
3. There is a strong focus on innovation, creativity, and technology.
4. What is meant by STEAME is projects including a minimum of 2-3 of these subjects, not necessarily all of them

2.3. Step 3: Establishing premises for the learning outcomes

Once the process of analysing the content of the competence frameworks selected was completed, step 2 of the conceptual mapping was finished. After that, we combined the results of this analysis with the two groups of results that were mentioned at the start, i.e. 1) Results that confirm the intentions and premises of the STEAME Teacher Facilitators Academy project; and 2) Results that become direct inspiration for the learning outcomes of the STEAME Teacher Facilitators competence framework. By combining these results, we aimed to establish premises for the determination of the learning outcomes.

The premises that were produced can be formulated as follows: "The support that we provide to teachers must reflect a view of PBL applied to STEAME that has the following characteristics":

- Practical, to be applied at classroom level
- Versatile: possible to apply to different contexts or target groups and be carried out in technology-mediated teaching situations
- Forward-looking, based on digital citizenship and sustainability
- Incorporates interdisciplinarity, by integrating a minimum of 2-3 STEAME subjects or areas of knowledge
- May use service learning as an operationalisation of PBL
- Has a component of internationalization, collaboration between schools or organisations from other countries
- May involve cooperation between schools and industry
- Includes ICT as part of the teaching and learning process, therefore something that teachers must be able to do in a transversal way
- Soft skills, teaching skills and pedagogical skills seem appropriate to represent teachers' learning outcomes in the STEAME project because they emphasize interdisciplinarity in PBL
- Organisational skills deserve a category as STEAME projects involve working with what happens outside of the class

2.4. Step 4: Determine and apply learning outcomes formulation criteria

The last step in the process to determine the learning outcomes assumes that there are many ways to formulate learning objectives. On this basis, the last step consists of establishing common criteria for the learning objectives of this project. More specifically, we applied the criteria proposed by the Centre for Teaching and Learning from the University of Oxford (University of Oxford, 2021):

1. Avoid jargon
2. Use action verbs to describe what it is that students should be able to do during and/or at the end of a session or course
3. Not be too numerous. This helps to avoid writing a list of 'content to be covered' and will also help you prioritise what students need to do
4. Be specific.

Concerning the use of action verbs, we used the revised Bloom's taxonomy (Anderson & Krathwohl, 2001). This is a list of verbs, classified in six, progressively more intellectually demanding groups, namely: 1) Remembering, 2) Understanding, 3) Applying, 4) Analysing, 5) Evaluating, and 6) Creating.

3. A SET OF LEARNING OUTCOMES FOR THE STEAME TEACHER FACILITATORS WORKSHOPS AND MODULES

According to the project proposal, the learning outcomes in this project are derived from merging, structuring and elaborating the results of the analysis of 24 projects carried out in deliverable D2.1. This work has been described in the previous section.

This section presents the set of learning outcomes that will guide the STEAME Teachers Facilitators modules and workshops. Then, how these learning outcomes cater for the two groups of teachers of this project, i.e. student teachers and service teachers, is explained.

These Learning Outcomes are currently undertaking a validation process within the project consortium. For this reason, they are available in English. When they are final, they will be translated into national languages, most certainly as part of the STEAME Teacher Facilitators competence framework that will be presented in deliverable D2.3 and/ or deliverable D2.4.

3.1. Set of learning outcomes

As a result of the analysis, we propose a set of learning outcomes, distributed in four areas. The set of learning outcomes of the STEAME Teacher Facilitators Academy project caters for its two target groups, namely student teachers and service teachers.

3.1.1. Set of learning outcomes for student teachers

Student teachers are understood as those who are undertaking initial teacher education at the moment of participating in the project. This includes preservice teachers, I.e. those who have never exercised the teaching profession, and in-service teachers who are enrolled in an initial teacher education programme.

The learning outcomes for student teachers are based on the following assumptions:

- Focussed on understanding key concepts of STEAME PBL education
- Stress on design and planning of STEAME PBL experiences that can be easily modified to meet the needs of the context in which they will be applied, probably in the future
- Allowing for more creativity

On this basis, the following learning outcomes have been defined:

Area 1: STEAME PBL activities as embedded in the formal education system

1. Design STEAME PBL teaching and learning activities that are aligned with formal education curricula and assessment standards at a local, regional and national level
2. Understand the need to coordinate STEAME PBL teaching with the school organisation, at a management level (school identity, yearly programming), department level (schedules, materials, resources, other subjects within STEAM), and subject level (objectives, contents and teaching methodology)
3. Brainstorm ways to involve educational agents in STEAME PBL activities, including other teachers and school managers, as well as national and international non-profit organisations and companies, and families
4. Define strategies for planning and monitoring student learning in STEAME PBL activities, including derivations from the plan
5. Explain how to use different assessment method/s to in STEAME PBL activities, which include reporting and keeping custody of learning evidences

Area 2: Students' meaningful learning through PBL across STEAME areas

6. Design Learning and Creativity plans to facilitate students' PBL in and across two or more STEAME subjects
7. Propose meaningful and authentic contexts that do not have a single solution to be addressed through STEAME PBL in the classroom
8. Explain the importance of defining and communicating the starting point and expected result or product of learning (portfolio, blog, video, poster, service, game…) in STEAME PBL learning activities
9. Identify teaching and learning strategies that engage students in interdisciplinary practices (act like scientists / artists / engineers / entrepreneurs...) as part of STEAME PBL
10. List strategies to manage student learning in STEAME PBL activities that allow to provide support or scaffolding based on students' progress
11. Understand the need to share or agree on a set of students' assessment criteria of STEAME PBL learning activities beforehand
12. Define a productive use of up-to-date technologies to facilitate student learning in STEAME PBL learning activities, including artificial intelligence, virtual and hybrid learning environments
13. Select and adapt digital content to support micro-learning, such as instructional videos and infographics
14. Plan STEAME PBL teaching and learning activities that balance students' individual and group work
15. Develop awareness about the need to create the classroom climate that favours self-guided learning, asking questions, sharing, coaching, and empathy

Area 3: Student ownership of their learning through STEAME PBL

16. Name strategies to involve students in choosing the context for STEAME PBL activities, out of recent developments in society or from their internal curiosity, through genuine personal or moral involvement
17. Define a strategy to promote student communication within small groups and with the whole class during STEAME PBL activities
18. Suggest general strategies to manage students' emotions while involved in STEAME PBL, including engagement and coaching
19. Develop an understanding of formative assessment strategies that can ensure students' self-regulation
20. Recognise the importance of metacognition as a tool to ensure that students integrate new competences / knowledge into existing ones in STEAME PBL Learning and Creativity Plans
21. Outline strategies to promote student collaboration within a group, including organisation, negotiation and decision-making

Area 4: Sustainability of PBL in STEAME

22. List actions that can foster a culture of feedback in the practice of STEAME PBL between students, between teachers and students, between colleagues or across the typical levels of school hierarchy
23. Understand the need to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
24. Understand strategies to critically reflect on one's own role and feelings after a STEAME PBL activity is completed, involving all participants of the learning process
25. Analyse the opportunities and threats to STEAME PBL as an innovation in formal education
26. Explain how creativity and adaptability to change can help in the design and implementation of STEAME PBL activities
27. Gain awareness of own skills that can facilitate the delivery of STEAME PBL teaching

3.1.2. Set of learning outcomes for service teachers

Service teachers are those who are actively carrying out teaching activities in a formal education institution (school, high school, etc.) at the moment of participating in the project and are not enrolled in any initial teacher education programme.

The learning outcomes for student teachers are based on the following assumptions:

- Strongly based on classroom practice, in practical application
- Oriented to action
- Consider the teacher as a professional that works in an institution where STEAME PBL is to be applied
- More focussed on learning to understand students' needs and abilities to deliver STEAME PBL teaching in a more productive way

On this basis, the following learning outcomes have been defined:

Area 1: STEAME PBL activities as embedded in the formal education system

1. Design STEAME PBL activities that are aligned with formal education curricula and assessment standards at a local, regional and national level, as well as with the curricular organisation of a specific school
2. Coordinate STEAME PBL teaching with the school organisation, at a management level (school identity, ethical and safety aspects, use of spaces and other infrastructure), department level (schedules, materials, resources, other subjects within STEAM), and subject level (objectives, contents and teaching methodology)
3. Create a communication strategy with the educational agents involved in STEAME PBL activities, including colleagues and managers within the school and outside of it, as well as national and international non-profit organisations and companies, and families
4. Define a strategy for planning and monitoring student learning in STEAME PBL activities, including derivations from the plan in the case of a specific school
5. Make informed choices about the most appropriate assessment method/s to use in a given STEAME PBL activity in a specific school, which includes reporting and keeping custody of learning evidences

Area 2: Students' meaningful learning through PBL across STEAME areas

6. Use Learning and Creativity plans to facilitate students' PBL in and across two or more STEAME subjects in a particular school
7. Propose meaningful and authentic contexts that do not have a single solution to be addressed through STEAME PBL with a particular group or groups of students
8. Practise defining and communicating the starting point and expected product of learning (portfolio, blog, video, poster, service, game…) in STEAME PBL learning activities
9. Identify teaching and learning strategies that engage a specific group of students in interdisciplinary practices (act like scientists / artists / engineers / entrepreneurs...) as part of STEAME PBL
10. Make up strategies to manage student learning in STEAME PBL activities that allow to provide support or scaffolding based on students' progress
11. Propose ways to share or agree on the assessment criteria of STEAME PBL learning activities beforehand with students
12. Demonstrate a productive use of up-to-date technologies to facilitate student learning in STEAME PBL learning activities, including artificial intelligence, virtual and hybrid learning environments
13. Create, modify and/or appropriately share digital content to support micro-learning, such as instructional videos and infographics
14. Plan STEAME PBL teaching and learning activities that balance students' individual and group work for a specific group or groups of students
15. Explain how to create a classroom climate that favours self-guided learning, asking questions, sharing, coaching, and empathy in a specific teaching and learning context

Area 3: Student ownership of their learning through STEAME PBL

16. Propose strategies to involve a specific group or groups of students in choosing the context for STEAME PBL activities, out of recent developments in society or from their internal curiosity, through genuine personal or moral involvement
17. Define a strategy to promote a specific group of students' communication within small groups and with the whole class during STEAME PBL activities
18. Suggest strategies to manage a specific group of students' emotions while involved in STEAME PBL, including engagement and coaching when needed
19. Design formative assessment strategies to ensure students' self-regulation
20. Argue for the introduction of metacognition in specific STEAME PBL Learning and creativity plans as a tool to ensure that students integrate new competences / knowledge into existing ones
21. Outline strategies to promote collaboration within a specific group of students, including organisation, negotiation and decision-making, based on their skills and needs

Area 4: Sustainability of PBL in STEAME

22. Make a plan to foster a culture of feedback in a specific school about the practice of STEAME PBL between students, between teachers and students, between colleagues or across members of the school hierarchy
23. Plan actions to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
24. Develop skills to critically reflect on one's own role and feelings after a STEAME PBL activity is completed, involving all participants of the learning process
25. Analyse the opportunities and threats to STEAME PBL when applied as an innovation in a specific educational context
26. Apply creativity and adaptability to change in the design and implementation of STEAME PBL activities
27. Gain awareness of own weaknesses to identify Professional Development opportunities for a better delivery of STEAME PBL teaching

4. CONCLUSIONS

This deliverable reached its objectives to the extent that it provided a list of Learning Outcomes that will guide the development of the workshops and training modules in WP3. The learning outcomes are grounded on the analysis of previous, European projects relevant to STEAME education. This makes this set of learning outcomes stand on solid knowledge developed by other academics and practitioners in Europe. By using validated learning outcomes design criteria, we believe that our proposal is robust and meets the standards of teacher education programmes.

Nevertheless, this task faced some challenges. Only a few projects included a competence framework, which 4 of these were context-dependent (eg. For climate change education), whereas STEAME includes different disciplines. Although the STEAME Teacher Facilitators Academy project focusses both on student and service teachers, most of the previous projects are aimed at service teachers.

As a result of the analysis, we propose a set of learning outcomes, distributed in 4 areas. The set of learning outcomes of the STEAME Teacher Facilitators Academy project caters for its two target groups, namely student teachers and service teachers.

The results of this deliverable will feed into task T2.3, which consists of developing the STEAME Teacher Facilitators competence framework.

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