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Deliverable D5.2
Interaction Model Design

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Executive Summary

The Up to University (Up2U) Project aims at bridging the high school – university gap by providing European schools with a next-generation digital learning environment (NGDLE) to help students develop the transversal skills and digital competencies they need to succeed at university.

From the Description of Actions:

This Deliverable from Work Package 5 Learning Community Management and Skills Training (WP5) will describe and analyse Up2U's pedagogical principles and policy and will provide some first analytical descriptions of the user roles, actions, social interactions, automated mediated actions, beside a preliminary model of the expected external interactions also in view of the design of learning analytics functionality and a set of suggestions and recommendations for the graphic user interface development.

The deliverable starts with a short introduction summarising three key actions in the workflow that led to our preliminary Interaction Model Design, as well as to the planned Action #4. **Actions #1**, **#2** and **#3** are described in detail in **Sections 2**, **3** and **4** respectively while **Action #4** is described in **Chapter 5**.

Section 2, Project Pedagogical Principles and Policies, describes Action 1, which is to identify skills and strategies to bridge the gap between secondary schools and higher education. It reports on the extensive literature review, comprehensive needs analysis surveys and in-depth teacher interviews we conducted across eight countries to answer questions such as:

- Which transversal skills and competencies have the widest gaps the between the "ideal" and the "real" level of attainment, according to the school principals, high school teachers and university lecturers?
- How are technologies currently being used in schools?
- To what extent have teachers in pilot schools already been trained to implement student-centred pedagogical approaches that can support the core set of target competencies identified in our survey?

As Section 2 shows, the results of WP5's data collection in Year 1 helped us to answer these and other key questions. The section describes the core set of target skills identified by the project as well as pedagogical principles and policies for developing these core target skills. Section 2 also describes how Up2U will expand the walls of the classroom to integrate informal, non-formal and formal education as an additional means of preparing students more effectively for university.

The section ends with a description of how the Up2U platform provides appropriate scaffolding for learners' activities within the Up2U ecosystem, and the four "destinations" on the students' path through this ecosystem are outlined: (1) Core target skills and competencies, (2) Student-centred

teaching methodologies, (3) Technology tools and solutions and (4) Digital competencies. The first two of these destinations are described in Section 2, with the third destination, Technology tools and solutions, described in *Deliverable D4.1 Application Toolbox Design and Prototype*. The fourth and final destination, Digital competencies, is addressed in Section 6, which summarises our initial contact and future plans to collaborate with SELFIE, an EU project that plans to reach hundreds of schools in Europe [SELFIE].

Section 3, Interaction Model Supporting the Development of Core Transversal Skills, describes Action #2, which is to defins the ecosystem and the Interaction Model Design suitable for bridging the high school – university gap. It starts with references to the literature on learning design and learning modelling which informed our preliminary Interaction Model, including the graphical user interface, followed by some examples and a summary of possible learning scenarios, to illustrate the practical application of the model.

Section 3 also provides an analytical description of the actors, user roles, actions and activities in the context of Up2U learning analytics, and outlines integration of Up2U's current NGDLE with an xAPI learning record store (LRS), and Learning Locker, which, in its basic open source configuration, already includes an "analytics dashboard" with considerable filtering and data aggregation capabilities. The section ends with a summary of a provisional repertoire of the learning interactions that Up2U's NGDLE should allow to be tracked in order to provide teachers, learners and other stakeholders with a first level of awareness of which data can be collected and which types of indications can be drawn from them. As reported in *Deliverable D5.3 Skills Report and Training Updates*, the project's Continuing Professional Development programme (CPD) will focus on preparing teachers to effectively "translate" these data into improvements in both the teaching and learning processes.

Section 4, Teachers and Students: Virtual Ecosystem Meets Real People, describes Action #3**,** which is to prepare teachers and students for using the ecosystem to promote the target skills through the identified learning models This section outlines design principles, strategies and activities of teachers' learning paths to answer the question of what type of professional development is needed to provide teachers with the additional knowledge and skills they need for effective integration of new technologies into their daily teaching practice. The rest of the section reports on what we have done until now to get teachers and students ready to use the project's NGDLE, test the model, build teachers' and learners' knowledge-sharing communities and organise students' interaction with the ecosystem.

Clearly, introducing technologies is not enough to positively influence educational practices, and Up2U's CPD, as described in Deliverable D5.3, will focus on equipping teachers with the knowledge and skills they need to make informed decisions regarding:

- How, why and when to introduce technology, based on contingencies such as the subject area, student numbers, levels of students' prior knowledge and learning objectives.
- The potential of technological tools to add value, as well as their possible constraints.
- Ways in which technology can support students' engagement and their development of Up2U's core transversal competencies.

In accordance with the Description of Actions (DoA), which requests a description of the expected external interactions (also in view of the design of learning analytics functionality), Section 5, A Taxonomy of Interactions with External Agencies (Non-Formal Learning Providers), describes Action 4,

which addresses the need for a unifying assessment framework to harmonise formal education with non-formal learning providers.

The section outlines a taxonomy of types of interactions with external bodies (non-formal learning providers) and includes examples of learning scenarios and macro-scenarios that represent interaction between non-formal learning providers and schools.

The final section of this report is Conclusions, Suggestions, Future Directions and Commitments. Our central conclusions relate to (1) the challenges facing the project and (2) the unique strengths of this project that will help the partners meet these challenges. The challenges include the general picture that emerges from the pilot schools, which shows a school world anchored to educational models in which the development of skills crucial for bridging the high school – university gap is made difficult by the lack of adequate preparation and dissemination of innovative practices that effectively exploit digital technologies to enhance teachers' role. Teachers and principals outline a reality where little attention is devoted to training and the subsequent implementation of, for instance, project-based learning models, and the use and reuse of open educational resources. Above all, a vision seems to be lacking that unites students and teachers as knowledge-sharing communities, working in direct contact with external agents such as universities and industry. In addition, as the results of our surveys and in-depth interviews with teachers in the pilot schools showed, these teachers represent a wide range of points along the "technology take-up" continuum and dealing with this wide diversity represents a key challenge for designing needs-based CPD not just across countries but also within the same country.

In order to meet these challenges, as described in this deliverable, Up2U's NGDLE is based on four key principles: Pragmatism, Flexibility of the entire Up2U ecosystem, Openness and Security: Each one of the software systems selected for the initial integration can be substituted thanks to a smart Docking System, so that each community will be able to reconfigure their own set of preferred open software, in accordance with the pedagogical principles specified for that specific learning community. If and when new challenges emerge, the system will then be ready for a flexible reconfiguration. Section 6 also provides a set of policy suggestions to support dissemination actions: it defines our very specific rationale to promote Up2U NGDLE as a complete, secure, flexible environment for non-formal learning organisations, and for national public educational communities.

Section 6 concludes with a summary of future actions that form a clear and coherent roadmap, showing what each Work Package is expected to do to help Up2U scale up the number of participating schools to meet KPI targets.

1 Introduction

Over the past decades, the labour market has changed rapidly across Europe, and new kinds of jobs and job requirements have emerged. These changes have resulted in an increasing demand for transversal skills, soft skills and core competencies, such as critical thinking, command and facility of language, foreign languages and numeracy skills. This shift means that the traditional high school curriculum is no longer sufficient.

To increase students' employability, high school teachers across Europe need to focus also on equipping their students with the transversal skills and digital competencies they need to succeed at university level, as well as in today's globalised workplace.

The central goal of Up2U's next-generation digital learning environment (NGDLE) is to help high school teachers use pedagogical approaches and technological tools aimed at developing core transversal skills and competencies that can smooth students' transition from high school to university.

One of the first challenges for the Up2U project was to define the Up2U concept of a learning ecosystem. This was done in *Deliverable D4.1 Application Toolbox Design and Prototype* [D4.1].

The Up2U NGDLE must address the needs of both students and teachers to be recognised as useful by all users, and to be able to scale up to its KPI number of schools.

The web, intended as an open, collective force, is effecting a big philosophical change to the way we think about knowledge, truth and "situated knowledge". The model of student-centred learning could be an answer to the problem of the accelerating rate of technological evolution in societies. Putting the learner at the centre of the educational process is a change that needs to be made in order to sustain the acceleration of innovation and keep up with its pace in educational processes.

Table 1.1 below summarises the steps that were taken to define a preliminary Interaction Model Design (black font denotes completed actions and grey font denotes ongoing and future actions). Action 1, the first step, identified the main goal and possible ways to achieve it; Action 2 defined a pedagogy-driven ecosystem, and Action 3 moved on towards the concrete use and implementation of Interaction Models in real learning contexts. Action 4 addresses the introduction of new assessment methods in secondary school, and will start in the next pilot cycle.

The actions are described in more detail in the subsequent sections of this document.

Action	What	How	Output
A1	Identify skills and strategies to bridge the gap between secondary schools	1. Explore key-skill policies and learning theories with a specific focus on informal learning.	a) A list of transversal skills considered by the policies and literature studied to be the most needed.

Action	What	How	Output
	and higher education.	2. Investigate teachers' views about skills and their pedagogical practices. 3. Combine results.	b) Pedagogical guidelines on promoting transversal skills. c) A list of critical points for an effective integration of informal and formal learning. d) A reasoned list of skills needed by students from teachers' point of view. e) Teachers' portraits. f) Teachers' best practices and use-cases.
A2	Define an ecosystem and Interaction Model Design for bridging the gap between secondary and higher education.	1. Establish the features of the ecosystem for bridging the gap. 2. Map out suitable learning scenarios. 3. Translate the scenarios into UML models.	a) A map of learning scenarios. b) A number of flexible interaction design models. c) Analytical descriptions of the user roles, actions and activities. d) Analytical descriptions of social interactions.
A3	Prepare teachers and students for using the ecosystem to promote the target skills through the identified learning models.	1. Define a teacher training model that can be piloted in the classroom. 2. Test the model. 3. Build a teachers & learners community. 4. Plan students' interaction with the ecosystem.	a) A teacher training model. b) A community of teachers gathering practical experience from the Up2U countries. c) A graphic visualisation of the students' path within the ecosystem: the results produced so far by Work Package 5 Learning community management and skills training (WP5), Task 2 Teacher skills development (WP5.2). d) A reasoned list of student-centred teaching models most suited to promote the key skills.
A4	Plan and implement innovative assessment methods bridging the gap between formal and non-	1. Provide a test environment for self-regulated learning and assessment. 2. Define models for mentoring teachers' use of assessment	a) Feedback data on different usage of tools and methods. b) A set of Open Badges and a repository of learning

Action	What	How	Output
	formal activities (to be carried out together with schools and non-formal educational organisations).	methods in order to enable easier interaction with non-formal education. 3. Implement self-assessment and the production of learning approach (LA) data in the pilot classroom.	scenarios and analytical approaches. c) An experimental framework in which guidance on learning data is provided to teachers and students.

Table 1.1: WP5.2 Workflow to build the Interaction Model Design: strategies and main results

2 Project Pedagogical Principles and Policies

This section details Action 1, the first step in defining a preliminary Interaction Model Design. The objective of this action is to identify skills and strategies to bridge the gap between secondary schools and higher education. The section covers the following topics:

- Background.
- Theories and models to promote a student-centred ecosystem.
- Identifying the core skills facilitating students' transition from school to university.
- Surveys conducted by WP5 across pilot countries.
- Summary: the anticipated students' path within the Up2U ecosystem.

2.1 Background

The Up2U project aims to develop a student-centred digital learning ecosystem that integrates formal and informal learning and, through the use of project-based learning, to develop transversal skills and digital competencies.

To achieve this aim, WP5 centred its efforts on:

1. Distilling the main theories and models that can be used to promote a student-centred ecosystem that supports competency-based education.
2. Deeper analysis and better understanding of Up2U's core goal of integrating formal and informal learning, in order to provide suggestions for developing an effective learning scenario.
3. Identifying the core-skills that facilitate students' transition from school to university and their further success.
4. Exploring what is state of the art in pilot schools in terms of technology-enhanced learning, student-centred learning, and the integration of formal and informal education.

The next sections describe how WP5 has followed this process and the outputs it has produced.

2.2 Theories and Models to Promote a Student-Centred Ecosystem

The basic learning theory underpinning the project refers to constructivist pedagogy, applied in today's world to learning environments that use blended (e-)learning methods.

Socio-constructivist teaching, in fact, revolves around the concept of situated and contextual learning within environments and situations in which students are required to apply and develop multiple skills.

We refer to constructivism in the social and cultural sphere, according to which knowledge is a construction mediated by cultural and social artefacts created at an interpersonal level through communication and interaction with one's peers and with experts [Vygotsky-Cole]. A key concept is that of mediation, central to the ideas of Vygotsky, according to whom our relationship with reality is always mediated by material or immaterial tools, created and continuously transformed as activities are performed.

2.2.1 Constructivist theories as the basis of our Interaction Model

Constructivist theories stress the need for learning processes to be active and, as far as interactionist constructivism is concerned, to be developed through interaction between the subject and the objects of the world surrounding him (Piaget). Social constructivism (Vygotsky, Bruner) moves beyond this relationship, and places social, cultural, dialogue-related and technological considerations at the centre of active learning. We learn, therefore, by doing and collaborating with others, interacting with and interpreting information, seeking dialogue and discussion, using the tools available in the culture we live in. Collaborative learning is thus founded on the idea that interaction among one's peers also sets learning processes in motion. These pedagogical approaches form the basis of our preliminary Interaction Model described in Action 2 in Section 3, where we identify and provide descriptions of example learning scenarios.

Table 2.1 below summarises the extensive review of the literature we conducted in Year 1 to identify pedagogical approaches that facilitate development of transversal skills.

Learning Concept	Implication
1. Learning as a non-linear process leading to unique outcomes	It is necessary to consider the way students learn outside the classroom and to go beyond rigidly pre-defined "sequences" of teaching.
2. Learning as an active and intentional process	Students must be engaged in activities and objectives that take account of their interests and are meaningful for their growth
3. Learning as a constructive process	Learning means building one's sense of reality, one's own representations, starting from the materials provided
4. Learning as a social process	Interactive moments are needed to negotiate meanings, advance collective knowledge, and solve problems
5. Learning as a self-reflective process	Technology-based spaces and tools that boost cognitive skills are needed both for personal reflection and for the development of one's self-regulation capacity
6. Learning as a situated process	The problems of real life must be transformed into learning opportunities, teaching students how to "read" reality and how to deal with it, using what has been learned at school

Learning Concept	Implication
7. Learning as not ending once the gates of the school are passed through	Informal learning is a powerful tool to support formal learning

Table 2.1: Conceptualising learning to promote a competency-based education

2.2.2 Learning Methodologies that Support Competency-Based Education

Table 2.2 below summarises six student-centred methodologies that can support development of most of Up2U's core target skills. These should be regarded as parts of a "menu" to which users will add approaches that meet the needs of their specific students.

Approach	Why this approach?
Project-Based Learning (PBL)	Supports the desired learning outcomes.
Flipped Classroom (FC)	This approach involves a reversal of traditional teaching: students gain first exposure to new material outside of class, usually via reading or lecture videos. Less time in class on transmission of information gives teachers more class time for supporting the harder work of assimilating that knowledge through small-group work and strategies such as problem solving, discussion or debates.
Place-Based Education (PBE)	PBE is anytime, anywhere learning that leverages the power of place, and not just the power of technology, to personalise learning. It is an immersive learning experience that places students in local heritage settings, museums, culture-related art and craft, landscapes, opportunities and experiences. PBE emphasises learning through participation in service projects for the local school and/or community.
Knowledge Building (KB)	KB is a theory developed by Carl Bereiter and Marlene Scardamalia [Scardamalia-Bereiter_2006] for describing what a community of learners needs to accomplish to create knowledge. It involves making a collective inquiry into a specific topic, and coming to a deeper understanding through interactive questioning, dialogue, and continuing improvement of ideas.
Trialogical Learning Approach (TLA)	TLA is a recent theoretical model developed by the Finnish researchers Saami Paavola and Kai Hakkarainen [Paavola-Hakkarainen_2014]. The particular skills targeted are those requested by the modern knowledge society: dealing with uncertainty, facing multi-faceted problems, solving real problems, and working with others.
Collaborative Learning (CL)	A learning method developed by Ann Brown and Joseph Campione [Brown-Campione_1994] based on interaction within a group of collaborating students, identified as a Learning Community, aiming

Approach	Why this approach?
	to achieve a common goal in terms of creating new knowledge and products. It shares some features with PBL, KB and TLA. CL uses the group's emotional and cognitive involvement as a learning tool and an alternative to the traditional frontal lesson. This term, therefore, refers to a set of principles, techniques and methods of conducting the class on the basis of which the students deal with the disciplinary study by interacting in small groups in a collaborative, responsible, supportive way and receiving evaluations based on the results obtained both from the individual and from the group.

Table 2.2: Six student-centred methodologies that support competency-based education

Selection of these specific student-centred methods was based on a review of the pedagogical literature and institutional reports [EC_2017], and involved much discussion between project members. One of the main factors that influenced the selection is that the crisis of the "jobs society", as it was known until a decade ago, is now evident: expectations of new kinds of jobs are now clearly apparent in all European countries. The labour market is rapidly changing with the increase in labour mobility. The solution, as identified by employers and institutions, lies in the flexibility and creativity of the educational profile. One of the main results of this analysis is an increasing emphasis on transversal skills and on solid basic competencies (such as critical thinking, command and facility of language, foreign languages and numeracy skills).

Clearly, the six teaching models outlined above are not prescriptive and are not intended to be adopted in an identical way in all European schools by all teachers; the same applies to the Up2U technological tools. Although many teachers are familiar with these teaching models, the general picture that emerged from our surveys showed that, in many cases, these models are not yet being widely implemented in the classroom. This may be due to the level and scope of the teachers' professional development, as well as to the abundance of pedagogical models and technological tools currently available, an abundance that teachers often find overwhelming and discouraging, and that may slow down integration of technology into the curriculum at school level.

Consequently, Up2U's central goal is not simply to introduce additional teaching models and technologies, but to empower teachers by enabling them to make informed decisions regarding selection and integration of teaching models and technological tools.

The first step towards achieving this goal is to give teachers (and students) a solid grounding in terms of pedagogical principles; the second is to give them practical help to make informed choices within the vast framework of technological opportunities through the Up2U ecosystem, today and in its future evolution. The main achievement in this respect would be to create a European trusted virtual space for educational agencies. The principle is similar to that which enabled the introduction of GPS in the car insurance market: if you are willing to sign an agreement of trust, I will recognise your good will by certifying you with educational credits.

There is no "killer methodology" for learning and for teaching. Our main advice is to privilege multiplicity and coexistence of diversity, and to keep improving the autonomous capacity for designing

your own educational framework. Technology today can be extremely effective in harmonising diversity, and Up2U is an innovative step in this direction.

2.2.3 Supporting Knowledge Innovation and Promoting Competencies

Teacher as Mentor-Tutor

The digital-media revolution has multiplied the educational potential of the constructivist movement. The structure of communication and of culture in general has changed, going from simple texts in a textbook to a prevalence of hypertexts circulating on the web. On the Internet, knowledge is not given a priori to be transferred (the transmission paradigm): not only is it mediated in a problem-solving dialogue (the interactionist, metacognitive paradigm), it is constructed as the result of the network of associations, notes, consultations, comments, references and other texts [Levy], involving individuals and communities. The teacher finds herself immersed in a network of relations, and takes on the role of facilitator, or of mentor-tutor. This concept of mediation and the role of the teacher as facilitator or mentor-tutor is a key component of the interaction model described in Section 3.

In the current decade the evolution of technologies and media (mobile devices, apps, social media, internet of things) has further accentuated the plurality of systems available for accessing knowledge, the delocalisation and customisation of learning, the emergence of peer-to-peer models, gamification, and finally the transformation of formal school systems themselves. These systems are being reorganised in interdisciplinary and transversal terms (a movement that started in northern Europe). Long-established barriers are coming down, since the school has traditionally been organised as an assembly line, with the rigid division of subjects, age groups, even gender, rigorous timetabling, severe blocking of creativity, body use and movement, and an emphasis on competition among individuals. Emerging models encourage collaboration and collective elaboration, progress by trial and error, with the development of creativity, innovation, flexibility and adaptation to the environment. There are now fresh possibilities of creating multi-disciplinary syllabuses, pooling educational resources that are available nationally, or in Europe or internationally, that also favour closer integration between training and education and the competencies possessed by businesses and public services, thus fostering more effective work placement.

In order to reinforce these new emerging models and possibilities as described above, learning should be reorganised into blended ecosystems. According to [Castells] these ecosystems can promote:

- The use of tools available on the Internet.
- Collaboration in research or research/action communities.
- Real-time access to up-to-the-minute research contents.
- The reuse of all available information and user-generated contents.
- The sharing of experiences based on learning by doing.
- The consequent spread and hybridisation of competencies coming from different worlds and sectors.
- The need for technologies that can scaffold and organise existing educational networks, making it possible for teachers and learners to share a virtual social space expressly dedicated to them and to their learning goals.

All these features are embedded in the next-generation digital learning environment (NGDLE) where they can support widespread learning communities in which students and teachers are no longer assigned rigid roles, but assume temporary positions from which to move, according to new demands of changing situations.

2.2.4 Integrating Formal and Informal Education

Optimal use of non-formal and informal learning to complement formal education represents a key component of Up2U's NGDLE. The following summary of the three basic types of learning systems is based on the ISCED (UNESCO) classification:

- *Formal learning*: this takes place in a structured, organised setting (e.g. school, vocational training course or certification of training credits, obtained at work); it is expressly designated as learning (number of hours, learning targets, learning materials) and conducted by a teacher; it leads to formal certification, i.e. a study qualification, e.g. secondary school certificate, vocational training certificate, university degree, Ph.D.
- *Non-formal learning*: this type is not expressly and permanently designed for an educational system; however, it does include planned activities and the presence of teachers, but not necessarily resulting certification, e.g. a language course at an accredited training agency or an art history course given at a museum without a final assessment, but useful as individual training.
- *Informal learning*: learning as a result of self-directed recreational, family and daily activities. It is not organised and structured in terms of targets, number of hours or learning materials. It does not result in certification, and in most cases, it is not intentional (e.g. learning from watching a film, volunteer activity, playing music in a band, etc.).

In the digital environment these three learning systems tend to overcome more easily traditional rigid divisions and to interact, creating an educational path that sees a key role played by informal and non-formal learning. The mass media and the web make up the environment for a myriad of individual learning courses or units, or at least for the acquisition of knowledge "chunks" that need to be organised and integrated with knowledge learned in the school curriculum. The web also makes it possible for users to reuse the information acquired, facilitating "hybridisation" between experiences and knowledge acquired informally, competencies and experiences acquired in non-formal ways, and learning in formal environments, conducted with the aid of a mentor.

In practice, there is no learning activity that does not mix together elements of the three systems. Therefore, when it comes to acquiring abilities and skills, the Up2U project views these three types of learning systems as a convergence of heterogeneous learning systems, rather than as separable learning systems.

Adopting the hybrid model also means moving beyond an overly restrictive vision of educational technology, which is often designed to prioritise the quantity of installations, tools, environments and available "contents" over educational strategies, and the quality of these technologies over practices and targets.

Since the informal experience emphasises the student-centred vision of teaching, then it should in particular:

- Be part of a project-based learning.
- Enable transversal skills (see Section 2.3).
- Stress multi-disciplinary aspects.
- Lead to the creation of an object/product.
- Lead to the creation of a "community of practice".

Technology-enhanced learning is de facto more and more a hybrid learning system where formal, informal and non-formal learning activities interact positively. Up2U proposes new directions, methods and a whole ecosystem to boost this spontaneous dynamic.

Measuring and Validating Non-Formal and Informal Learning

The problem of how to measure and validate non-formal and informal activities has mainly been tackled in terms of vocational training. In this field, for example, we have models and templates produced by CEDEFOP [CEDEFOP].

In recent years countless free learning objects and courses have been made available on the Internet in new non-formal systems: these are in particular massive open online courses (MOOCs) [Rosewell-Jansen] at a university level, going from sets of lessons to interactive courses, with final certification [Ferguson-Scanlon-Harris]; and open educational resources (OERs) [OECD], learning resources that can be created by individuals and by communities. In the international debate, the question of open educational practices (OEPs) is becoming more central, focusing on teaching strategies for reusing OERs: seeking new practices to use OERs to transform learning; OEPs to enable the construction, sharing and qualitative review of knowledge assets. This implies a paradigm change [Paavola-Lipponen-Hakkarainen, Ehlers]; this will be one of the new skills that Up2U's professional development (PD) will focus on.

We selected, with the teachers involved in the project, the main methods and strategies to integrate informal education within formal education methods and strategies.

The Up2U NGDLE is built upon two previous projects that addressed the need for OER repositories: EduOER and CommonSpaces. This need will represent a main focus in Up2U PD.

There are, however, few reference points to identify a procedure for validating informal learning in a broad sense, namely: self-directed learning[1]; activities developed based on cultural interests and entertainment (cinema, theatre); social engagement and community experiences. This is because such activities are deemed to be random, unintentional activities, or not organised as part of a learning path, but no less important, as they are in any case guided by a "drive" to know things.

So, let us consider the most common method, at least in the sphere of "vocational" learning, used to assess and validate informal learning. Four steps are involved:

- Identification of the results of learning (learning outcomes), broken down by knowledge, abilities and skills of the non-formal/informal (Recognition).

[1] The terms self-directed learning or self-regulated learning are used from now on with the same meaning. Self-regulated learning is perhaps more appropriate for denoting non-formal learning activities where some direction comes from an external authority (non-formal organisation).

- Production of evidence on the part of the candidate (Documentation).
- Evaluation of the results of learning (Assessment), or validation.
- Certification of the results achieved.

A specific formalisation will be introduced in Section 4 for non-formal regulation inside the formal educational institutions. We end this section with a list of features that we consider as necessary for our NGDLE to support the integration of informal and formal education:

- Using tools and strategies to include informal experiences in the student's educational path according to key skills and key competencies.
- Creating a system that makes students' informal experiences traceable and transparent.
- Encouraging discussion and conversation as empowering tools.
- Creating a portfolio for the recognition, documentation, assessment and certification of informal practices in the formal curriculum.
- Designing a system for the assessment of informal experiences according to an agreed set of indicators [UNESCO].

2.2.5 Key Words for the Up2U Ecosystem

The logic that drives the Up2U pedagogical principles and policy is mainly based on four key words:

- Pragmatism.
- Flexibility – of the entire Up2U ecosystem (pedagogical and technological aspects).
- Openness.
- Security.

We will demonstrate flexibility in our progress to meet the diversity of new schools entering the federation and in authorising a quick integration of other tools on demand by further learning communities.

Pragmatism, flexibility, openness and security are the main added values of the Up2U ecosystem. We are already compliant with these principles in our first pilot instance.

These four concepts help the project manage three constraints that currently characterise the pedagogical and didactic context and reality of our participating schools:

1. Heterogeneity of the educational systems in each participating country.
2. Extremely wide diversity of infrastructure in these countries.
3. Teachers' need for independence and autonomy instead of having a top-down project that prescribes what to do and how they should behave in their classrooms.

2.3 Identifying the Core Skills Facilitating Students' Transition from School to University

In addition to WP5's main goal of providing a menu of pedagogical principles and policies that support development of transversal skills, a huge theoretical and practical effort was devoted to identifying the skills on which to focus our overall project.

The following sections describe the review we conducted on literature and government policy in order to define the set of skills deemed necessary for tomorrow's citizens.

2.3.1 Comprehensive Exploration of the Literature on Transversal Skills

"Which skills for the 21st century?" This question has been tackled, variously, around the world by such economic, educational and political institutions as UNESCO, OECD and the European Union, and by individual national governments. For decades, various international agencies have sought to set out a framework for the evolution of key skills in relation to education and training, and the demands of labour markets.

Although the literature on this subject is complex and wide-ranging, our in-depth analysis of published reports from key research bodies such as UNESCO and OECD in Year 1 indicates that key (cross-curricular) skills are aggregated into three main groups:

- Media and Information Literacy (MIL).
- Cognitive Skills.
- Soft Skills (Character-based/Psychological Skills).

2.3.2 Media and Information Literacy (MIL)

MIL skills include competencies relating to the selection and evaluation of information and its application in an ethically correct manner (i.e. what was, until recently, identified as ICT skills), and competencies involved in media operation, and the use of media and digital content for problem solving and the production of creative content (for the purposes of developing knowledge and skills, and self-expression). MIL skills are crucial in students' educational development because they are tightly linked to both the cognitive abilities required for specific tasks, and the acquisition of interpersonal skills (character/psycho-social or soft skills). In recent years, UNESCO has encouraged the promotion of ICT skills that contribute to greater computer literacy – knowledge of software and hardware programming and setting-up databases, and the ability to use different devices (tablets, smartphones, etc.) – but also of skills that are relevant to the use of media languages, reusing digital content and the creation of original products. In the field of MIL development, case studies and research papers have generated a set of literacy categories based on the media types and contexts in which the relative content is generated – Library Literacy, News Literacy, Digital Literacy, Internet Literacy, Cinema Literacy, Games Literacy, Television Literacy and Advertising Literacy – as well as a grouping of competencies relating to freedom of expression and freedom of information.

According to UNESCO, three different elements should form the basis of MIL skill acquisition: a) Information access skills, b) Information evaluation skills, and c) Skills for communicating and creating new information and content.

From the European perspective, the DIGICOMP–IPTS project (2011-2013) included a detailed framework of digital competencies developed by the Institute for Prospective Technological Studies (JRC-IPTS), one of the seven research centres that make up the European Commission's Joint Research Centre. The framework includes five cross-curricular areas of digital competency: Information, Communication, Content Creation, Security, and Problem Solving. In the 2016-2017 academic session, the Assessment of Transversal Skills 2020 (ATS2020) project [ATS2020] began transversal skills testing using the Mahara platform [Mahara][2] (which was also employed by the EuFolio project [EuFolio] in 2013-2015). The ATS2020 project provides one of the more up-to-date reference points. Financed by the EU over the period 2015-2018, it involves 17 partners from 11 countries and aims to develop a learning model that will help enhance "student indispensable transversal skills within curricula" and offer teachers "new approaches and innovative tools […] for the development and assessment of these skills." [ATS2020]. The ATS2020 Competences and Skills framework comprises four main areas: Information Literacy, Collaboration & Communication, Autonomous Learning, Creativity and Innovation. For the (Media) Information Literacy area, skills are considered that enable students to carry out research on the web as well as in physical spaces. These include abilities to do the following:

- Set strategies for data research that are consistent with the main objectives of a project.
- Select the most appropriate sources and tools for each task.
- Locate, manage, evaluate and summarise information, and use it ethically.
- Process information and create new knowledge.
- Integrate new knowledge and apply it to specific situations.

2.3.3 Cognitive Skills

Among current definitions of cognitive skills, the updated, streamlined description proposed by the World Economic Forum (2015) is particularly interesting. It essentially equates cognitive competencies to "how students approach complex challenges". They are required if students are, in turn, to develop the competencies required for specific tasks, and are grouped into four areas [WEF]:

- Critical thinking / Problem solving.
- Creativity.
- Communication.
- Collaboration.

Most key organisations involved in the study of 21st-century education in the United States employ the same range of categories, including the International Society for Technology in Education (ISTE) [ISTE] and, particularly, the Partnership for 21st-Century Skills (P21) [P21]. Looking at the situation in Europe, as we have seen, the definition of skills is in constant evolution. Besides skills related to (Media)

[2] During the 2016-2017 academic session this testing involved 250 schools, 1000 teachers and 10000 students between 10 and 15 years of age.

Information Literacy, the ATS2020 framework identifies three skills areas, all of which are associated with cognitive skills:

- Collaboration and Communication: include the development of skills that enable students and individuals in general to collaborate with people from different backgrounds on common projects, share ideas and content in physical and online space, engage in joint projects, produce and publish shared work.
- Creativity and Innovation: urge students to explore their imagination and creative minds. It is about identifying needs in existing circumstances, exploring solutions, using existing tools and resources to produce works of originality and innovation, and effect change.
- Autonomous or Self-Directed Learning: refers to a self-reflective process that enables students to take responsibility for their own learning. It entails setting individual learning goals, assessing status of knowledge, developing strategies to fill the gaps and achieve learning goals, as well as deciding how best to evidence achievement. [ATS2020-Transversal]

2.3.4 Soft Skills

Soft skills – also called character skills, psycho-social skills or social and emotional skills – concern the development of the individual's emotional and character-related attitudes in interpersonal relationships, in collaborating with others and in managing people. There are differing perspectives on soft skills. McCrae and Costa identified "Five Factors of personality" (the "Big Five") [McCrae-Costa]; Burrus and Brenneman [Burrus-Brenneman], meanwhile, have extracted three skills categories relating to school curricula, along with relative sub-skills. The OECD has focused particularly on the role of social and emotional skill development throughout the individual's scholastic career (including at an extracurricular level), and how this is manifested in different countries.

It also stresses the connection between cognitive and character skills, since both areas are related to certain qualities and abilities such as creativity and critical thinking [OECD-Skills].[3]

Building on the work of Gardner [Gardner], Sternberg [Sternberg] and Morin [Morin], in 2015 the Center of Curriculum Redesign [CCR], a non-profit organisation linked to the OECD, UNESCO, the World Bank, and a number of large foundations, academic institutions and multi-national companies, set out a framework of "character qualities" – Mindfulness, Curiosity, Courage, Resilience, Ethics, Leadership – which relate, in the context of curriculum design, to cognitive skills and knowledge.

2.4 Surveys Conducted by WP5 across Pilot Countries

To directly involve schools and universities in the project, as well as to integrate our exploration of the literature with real school-life, WP5 conducted an extensive needs analysis that identified:

- Skills that school teachers and university lecturers believe to be fundamental for a smooth transition from high school to university.

[3] The Centre for Educational Research and Innovation (CERI), attached to the OECD, is carrying out a "Longitudinal Study of Children's Social and Emotional Skills in Cities (LSEC)", a study on socio-emotional skills among students in their 1st and 7th years of schooling (Ages 6 and 12) over the period 2013-2019 [OECD-CERI].

- How technologies are currently being used in schools.

Surveys were conducted in all the countries involved in the project, coordinated by the Sapienza working group. Partners collaborated in all phases of the surveys, from design to rollout and analysis of the gathered data.

Teachers answering the surveys were distributed as follows:

- 131 school teachers from 6 different countries: Lithuania (60), Italy (29), Spain (15), Poland (10), Hungary (9), Portugal (8). The distribution of disciplines was: foreign languages (11%), humanities (28%), science (12%), math (17%), technology (32%)

- 281 university teachers and lecturers from 8 different countries: Poland (85), Lithuania (68), Greece (68), Italy (29), Spain (15), Hungary (7), Portugal (6), Israel (3). The distribution of disciplines was: foreign languages (15%), humanities (25%), science (16%), math (12%), technology (29%), arts (3%)

We are aware of some methodological limits concerning the surveys, mainly related to the sample not being equally representative of the respondent countries, as well as being numerically uneven between university lecturers and schools. We are also aware of some possible disadvantages regarding the use of a convenient method of sampling. However, as can be seen from the above description, these surveys were extremely comprehensive and completing the survey required a significant amount of teachers' time. In order to obtain as many completed responses as possible, surveys were mainly directed to pilot schools that had already expressed interest in participating in Up2U.

2.4.1 School Teachers' and University Lecturers' Perceptions of Required Skills

This survey was based on the literature review described above, and aimed at exploring a predetermined set of skills, collecting and cross-referencing the views of school teachers and university lecturers, in order to identify skills they view as most important. In addition, school teachers were also asked to indicate the extent to which high school graduates have each skill, to allow us to gauge the size of the gap that exists between expectations and reality.

The questionnaire investigated perceptions regarding 60 skills, in 13 areas: 1. Information, 2. Text Processing, 3. Data Processing, 4. Media and Communication, 5. Media Languages and Production, 6. Creative Content Reuse and Storytelling, 7. Critical/Strategic Thinking, 8. Thinking the Environment, 9. Tools Management, 10. Creative Thinking, 11. Self-management / Flexibility, 12. Self-management / Resilience, 13. Social Relationships Management.

These skills grouped into 3 macro-areas:

- Media and information literacy [MIL].
- Cognitive skills.
- Socio-relational skills.

2.4.2 Results of Surveys

According to school teachers, the main skills required by students entering university are as follows:

MIL abilities ranked top, together with "*evaluating information validity and credibility*" (3.64), followed by "*browsing, searching and selecting information*" (3.63) and "*consulting efficiently libraries and archives*" (3.46). Some character skills also play a substantial role, including socio-relational competencies: "*cultivating self-esteem and confidence"* (3.45), "*being passionate about own interests*" (3.43), and "*collaborating with others to solve problems*" (3.42) and "*working in a team*" (3.01).

In contrast to school teachers, university lecturers viewed character and socio-relational skills as most important, with "*respecting other people's ideas*" (3.40) and "*collaborating to solve problems*" (3.34) ranked in top place, followed by being "*passionate about own interests*" (3.16). Additional skills in university lecturers' "Top Ten" included "*taking notes efficiently*" (3.20) and "*becoming an autonomous self-directed learner*" (2.90,) and MILs such as "*browsing, searching and selecting information*" (3.31), "*understanding and analysing complex text*" (3.10) and "*evaluating the validity and credibility of information*" (3.02).

University lecturers' responses stressed as a crucial point: *Promoting critical skills* (67%), *Improving teaching learning methods* (18%). School teachers' responses stressed: *Improving teaching learning methods* (17%), *General recommendations* (14%) and *Promoting Up2U skills* (14%).

According to university lecturers, *Critical thinking, autonomy and responsibility, collaboration, writing and reading, creativity* are the top 5 skills students should have. In contrast, according to school teachers, *Autonomy and responsibility*, *motivation*, *IT*, *languages* and *critical thinking* are the top 5 skills students should have. This contrast can be clearly seen in Figure 2.1.

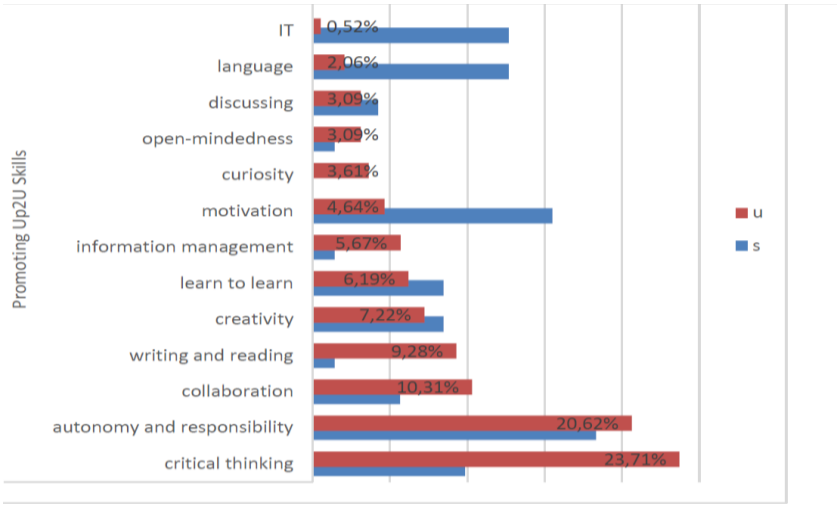

Figure 2.1: UP2 Skills perceived as most necessary by school teachers and university lecturers

Finally, comparing teachers' opinions about the skills needed and skills achieved, it was possible to identify the skills showing the greatest gap. These are the skills to which the most attention needs to be paid, and which form the focus of Up2U's PD programme. The first 15 skills with the greatest gap fall mainly in soft skills (social relationship management, self-management / resilience, self-

management / flexibility), followed by specific competencies in text processing and critical/strategic thinking. The top four in the first 15 skills with the greatest gap were:

- *Evaluating the validity and credibility of information* (gap 1.60).
- *Perseverance despite effort or failure* (1.37).
- *Handling of work with effective and self-disciplined time management* (1.34).
- *Management of conflicts by searching for effective mediation* (1.31).

Regarding Improving teaching learning methods (Figure 2.2), school teachers and university lecturers almost agree on how to improve the approaches, that is, by introducing innovative methods, including practical, collaborative and project-based learning.

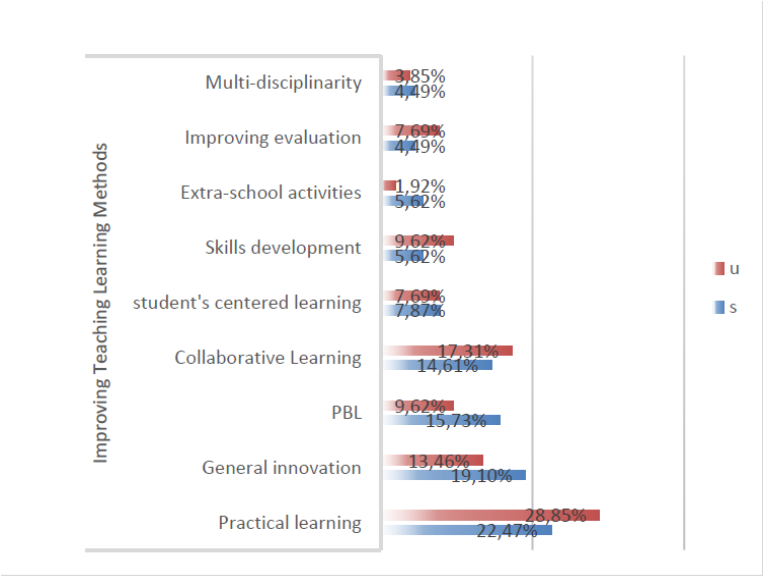

Figure 2.2: Teaching learning methods to bridge the gap according to school teachers and university lecturers

The skills questionnaire also contained two open-ended questions:

- University lecturers were asked to list the 3 most important things school teachers could do to prepare their students more effectively for college or university.
- School teachers were asked to list 3 concrete ways in which the school could increase the number of students accepted at university.

By means of a qualitative analysis, 11 categories of "solutions/areas of improvement" were found, which provided several valuable practical suggestions for additional ways, beyond development of transversal skills, for bridging the high school – university gap. These included university-school partnerships with University as Knowledge Hub and Career Guidance Centre, which we plan to incorporate into future phases of the pilots.

In conclusion of the skills questionnaire, we can make a final observation: university lecturers and school teachers clearly understand that, in order to support students in the transition, it is absolutely

necessary to *reform teaching models towards a student-centred vision of learning* and to promote the skills they themselves identify as being critical. These are summarised in Table 2.3.

Area	Skill
Socio-relational	• collaborative problem-solving • team-working • appreciation of diversity • project management
Cognitive	• critical thinking • foreign languages
Character-based	• autonomy • resilience • motivation • self-esteem • flexibility
Knowledge work/MIL	• selection and validation of information • IT

Table 2.3: The Up2U core skills

2.5 Summary: The Anticipated Students' Path within the Up2U Ecosystem

The Up2U platform focuses on classifying and organising learners' activities to achieve the desired target skills using suggested methodologies. Figure 2.3 provides a graphical overview of their path within the Up2U pedagogical framework.

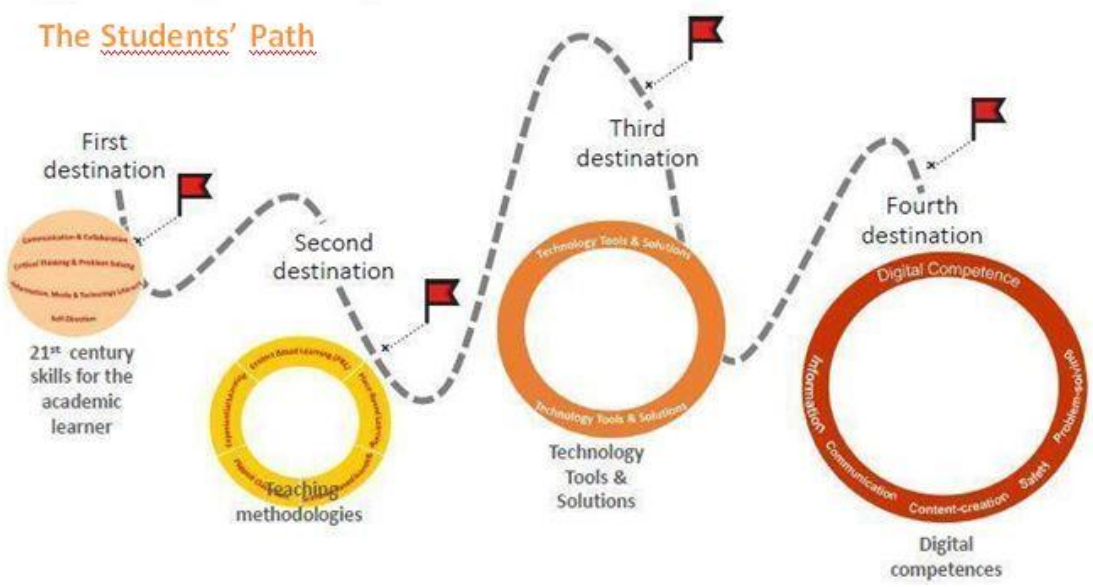

Figure 2.3: The students' path (see D4.2)

The first destination is about the four main skills the students will acquire (or reinforce) using the ecosystem:

- Communication & Collaboration.
- Critical Thinking & Problem Solving.
- Media & Technology Literacy.
- Self-direction.

It is important to underscore that the learners might be unaware of these goals at the beginning of their interaction with the system. The essential part is that at the end of it, the learners will acquire these skills (or a part of them) to achieve the so-called DigiComp 2.0 as set by the EU studies and assessed by a third-party organisation, be it IEA or SELFIE, as described in Section 6.

The second destination for learners is the methodology they will use to acquire the skills (see Section 2.2.2 and annexes):

- Project-Based Learning.
- Place-Based Education.
- Scenario-Based Learning.
- Flipped Classroom.
- Experiential Learning.

As part of these methodologies, learners will interact with the ecosystem within 4 kinds of scenarios, described with the support of example Learning Scenarios, in Section 3:

- Classroom-based (or formal) interaction.
- Internet-based interaction.
- Non-formal institution-based interaction.

- Personal project-based (or informal) scenarios.

Obviously, the interaction between users and the ecosystem will be mediated by tools that support all tasks needed by the pedagogical models listed above. These tools are provided by the system via the tool box presented in *Deliverable D4.1 Application Toolbox Design and Prototype*, which states:

> *"(Our) main requirement is to create a learning platform which is accessible in both desktop and mobile contexts, with federated Authentication and Authorisation Infrastructure (AAI), cloud storage, learning analytics capture and the ability to integrate arbitrary formal and informal educational tools and Open Educational Resources (OERs) easily and in accordance with specified pedagogical models."*

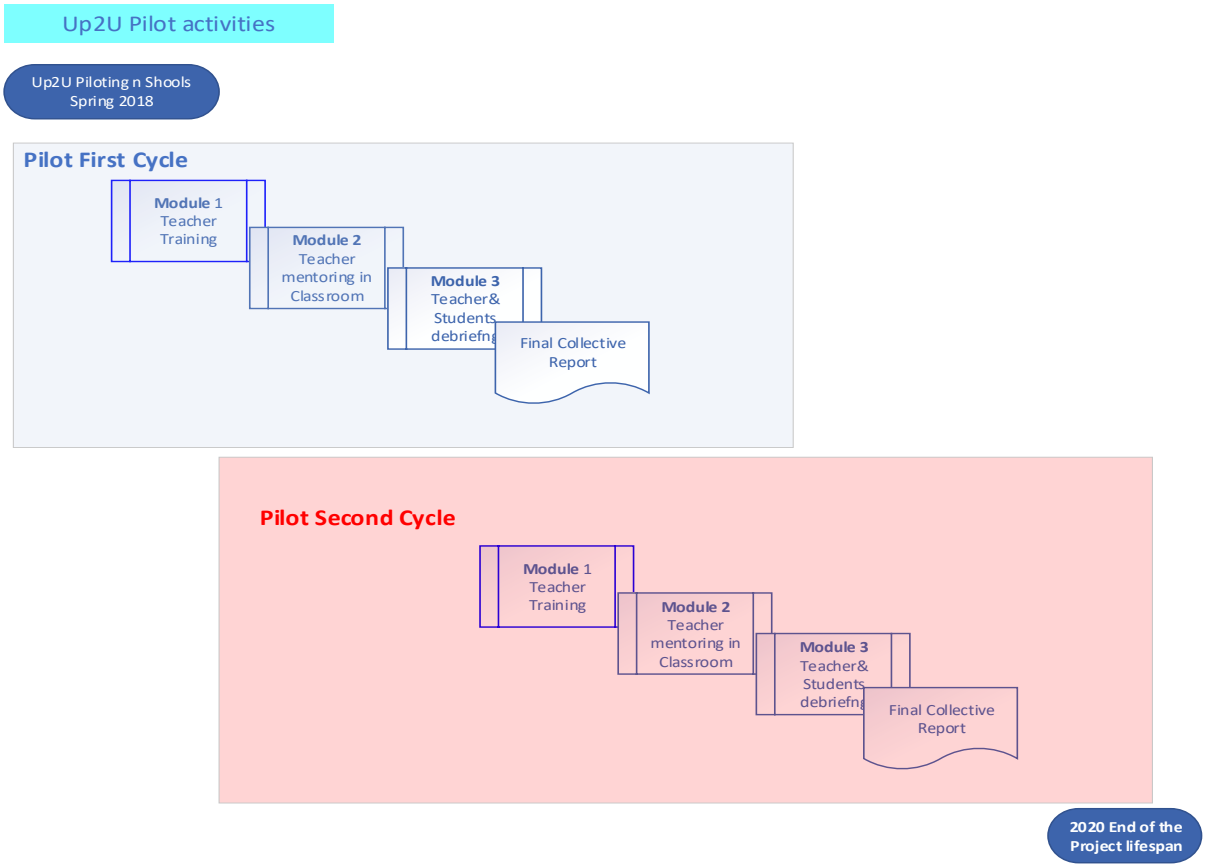

Figure 2.4: Pilot workflow with the teacher training path module and students' and teachers' activities

3 Interaction Model Supporting the Development of Core Transversal Skills

This section describes Action #2, which defines the ecosystem and the Interaction Model Design suitable for bridging the high school – university gap. It covers the follow topics:

- The next-generation digital learning environment.
- Graphical user interface development.
- Learning design and learning scenarios.
- Learning scenarios in the Up2U community.
- Two examples of learning scenarios.
- An analytical description of the actors, user roles, actions and activities in the Up2U learning analytics context.

3.1 The Next-Generation Digital Learning Environment

To help high school teachers across Europe better prepare their students for university, we focused on a central concept: a next-generation digital learning environment (NGDLE) or "open garden" that moves beyond the rigid confines of a "walled garden" or conventional learning management system (LMS). The flexibility of our NGDLE will enable Up2U to meet the challenge of providing needs-based professional development to teachers who are at very different points on the technology-uptake continuum, and who work in widely diverse pedagogical and didactic local realities. Crossing these widely differing contexts, Up2U's NGDLE will centre on the unifying concept of the core set of transversal skills and competencies that students need in order to bridge the high-school – university gap.

Starting from schools' real, pedagogy-driven technological needs, as identified in the surveys described in Section 2, we selected a series of tools that support the suggested methodologies.

Up2U is open mainly to 2 different use cases: a teacher (a community of teachers) engages his school to adopt Up2U to better cope with informal learning activities; a student (or a community of students) from the public Internet should be able to engage his school to adopt Up2U to recognise informal or non-formal learning activities.

These tools include, at the first stage:

- A generic learning management system (LMS) that captures the context of the learning.
- An open educational resource (OER) content substrate, to feed high-quality curated learning materials into the system.

- A federated and privacy-aware enterprise file sync and share (EFSS) and collaboration platform that crosses boundaries.
- An enhanced learning analytics function integrated with many components of the ecosystem.
- A whole trust and identity management framework (described in detail in *Deliverable D4.2 Enhanced Application Toolbox and Technical Specifications* [D4.2] and *Deliverable D6.2 Security, Privacy and Identity Roadmap*) [D6.2].

In addition, Up2U deploys a central cloud instance of the Up2U ecosystem, accessible from the public Internet. Schools in the participating pilot countries are invited to use this cloud instance, initially, in the first stage of the project, for teacher training purposes; but also to start experimenting with real-life teaching and learning practices involving their students.

During the second phase of the pilots project, Up2U will make the entire vertical software stack available open source on GitHub, with deployment and configuration support in Docker containers. This allows any infrastructure provider, either public or private, to take the platform as is and easily deploy it in a national or regional scenario. The modular architecture makes it possible to swap functional elements in and out, or replace them with other vendor products, as well as to exploit the existing already-deployed systems at schools or in the national R&E infrastructures.

This implementation process, started in the first month of the project, will continue until the final phases of piloting, in accordance with the nature of the ecosystem: flexible, dynamic and adaptable to the request of stakeholders. It is described in more detail in Deliverables D4.1 and D7.*1 Initial Pilot Architecture, Software Component Integration, and Deployment*.

These technological achievements were reached after comprehensive discussions between the pedagogical experts and the technical implementation team. The interaction, testified by the continuous meetings on these subjects, lasted throughout the first year of the project. The testbed instance was delivered with some months' delay, in March 2017. This caused a general delay of 3-4 months of the piloting experiences.

3.2 Graphical User Interface Development

From the DoA: [D.5.2 will provide] a set of suggestions and recommendations for the graphic user interface development. In the implementation of the project this task will be the object of attention in WP7, when students will be involved.

This section outlines the suggestions and recommendations we followed to build the NGDLE graphical user interface (GUI).

The importance of the graphical user interface is well known in the context of ICT, especially in the Internet world, where standards change very fast. A case study about it is the affirmation of the Google portal against the Yahoo portal at the end of the '90s. It is often stated that the graphic minimalism of the Google portal was an important plus in its affirmation against the graphically complex Yahoo home page. The users our project targets are largely students, millennials who grew up using the Internet, a community very sophisticated in terms of Internet usability. For this reason, the NGDLE GUI is very

important, and it is carefully analysed in Deliverable D4.2, where the main design principles are described in detail. The general guidelines are as follows:

- Keep it simple.
- Make the interactions efficient.
- Be consistent in the design.
- Use familiar design patterns.
- Understand how user interface (UI) and user experience (UX) interact.
- Implement a visual hierarchy.

Starting from these general principles, we identified the following ten user-requirement-based suggestions for creating an effective GUI:

#	User requirement	Motivation
1	The graphics must be highly responsive	We expect that most users will interact with the platform mainly via smartphone, at least at the beginning
2	Colour pictures should be used as background, at least in the welcome page. Themes should be related to the project itself (students, teachers, schools, classrooms, people using smartphone or devices, etc.)	It is important to give users a positive first impression in terms of vivacity (colours, concrete subjects such as people) and familiarity (users should feel familiar with the themes suggested by the pictures)
3	Text should have a maximum word limit, especially navigation text	Written words, especially in smartphone screens and so on, risk limiting user's curiosity to understand better the spirit of the project
4	Strong impact sentences should be displayed on the home page to attract new users	Meaningful sentences, at least for the target users, can be effective in stimulating curiosity working as commercial ads.
5	The Up2U ecosystem should be described from the beginning in a very practical way, e.g. creating a menu of the services available via SSO on the top of the page	Users should be able to appreciate the project richness and strength at glance
6	Graphically speaking the project home page and the Moodle system should be separated to avoid confusion	The Up2U NGDLE is not just a Moodle platform: they should be different also from a graphical point of view
7	It would be beneficial to alternate the use of big pictures and concise sentences in the home page	It is important that users feel the home page is professional and attractive: movement can be helpful
8	The colours used should be warm, to invite people to stop and to navigate within the ecosystem	It is important that users feel the home page is professional and attractive: Warm colours can be a plus.
9	Logo should be situated in a position that is easy to see (top-left corner is an option) and be fixed	Users should always know where they are: logo position is important

#	User requirement	Motivation
10	Logo-related colours and styles should be used for the home-page button (e.g. the button “READ MORE”)	An easy-to-understand colour code can be helpful for navigation

Table 3.1: Graphical user interface requirements

The efficacy of these 10 suggestions will be verified, after the pilot period ends, in Deliverable D7.2.

Furthermore, WP7 will start collecting feedback from students and teachers regarding the graphical user interface: all aspects of the GUI, e.g. look and feel, ergonomic and structural organisation of the GUI throughout the NGDLE, will be checked against a feedback collection model.

3.3 Learning Design and Learning Scenarios

This is an extract from a 2001 report by Rob Koper, Open University of the Netherlands [Koper]:

> “*The major question from a perspective of use in real educational practice is: does this model of learning objects and packages provide us sufficient means to build complete, flexible and valid units of study to be delivered through learning management systems?*
>
> *The answer is clearly ‘no’. From an educational perspective it is not enough to have learning objects and metadata as such. Different types of learning objects have different functions in the context of real education. A study task and a study text have both a different function in a unit of study. This is also true for tests and (e.g.) communication facilities. [...]. To put it in another way; there is a lack of a containing framework. The learning object model expresses a common overall structure of objects within the context of a unit of study but does not provide a model to express the semantic relationship between the different types of objects in the context of use in an educational setting. As a result, the learning object model also fails to provide for a model of the structure of the content of the different objects. The typing of objects also varies according to different pedagogical stances, so there is a need for a meta-model to describe the relationships. The basic idea we have elaborated is to:*
>
> 1. *classify, or type, the learning objects in a semantic network, derived from a pedagogical meta-model,*
> 2. *build a containing framework expressing the relationships between the typed learning objects,*
> 3. *define the structure for the content and behaviour of the different types of learning Objects.*

This extract testifies that the path to present-day Experience API (xAPI)-enabled learning design (LD) has been long and winding.

In Up2U we decided that one major condition to be compliant with, in relation to valorising informal and non-formal learning, is the autonomy of the learner community. This design principle has led us to work closely with teachers to design an experimental environment, that is, to proceed, step by step, to prototype and experiment with (test and revise) learning scenarios with the leading participation of teachers.

The IMS-LD standard, proposed by the IMS and the OU of the Netherlands, is still a reference for modelling learning processes, although it has not been widely disseminated in practice. We found, in the literature, that xAPI can be used with advantage to enrich the analysis of learning scenarios and the design of learning paths based on the IMS-LD, or on similar approaches, such as the one that has been used during the first cycle of the Up2U pilots. Besides the basic concepts and goals on which xAPI is based, we deem very relevant for Up2U the results of the work that has been done while building "xAPI profiles", that is, reusable vocabularies of "verbs" (generic actions) and "activity types" (needed to qualify verbs). They can simplify the task of a learning designer, or a teacher, especially in the formalisation of the interaction model of "external activities". Appendix D presents a list of xAPI "recipes" for typical generic scenarios; each recipe lists typical actions (verbs qualified with activity types) for the associated scenario. They can be considered a useful reference in analysing the Up2U scenarios and in annotating them from the viewpoint of tracing activities and enabling analytics.

3.4 Learning Scenarios in the Up2U Community

Today, most of the authors dealing with learning design and experimenting with xAPI suggest that one should implement an interactive environment, even to design experimental hypotheses.

The Subject Matter Committee (SMC) and the team of mentors are the real guides for the design of learning scenarios. Learning analytics tools must be presented to teachers to achieve their full participation in designing learning modules and analytics as protagonists, not in a co-primary role.

Table 3.2 below provides a compendium of real learning design activities being carried out with the involvement, to varying degrees, of the team of mentors, of SMC members and of different actors in the role of learner.

We report it here because it is useful to understand and evaluate the continuous development that the initial Up2U community is undertaking inside and outside classrooms, to engage schools in experimenting with the evolving NGDLE that we are building together with our stakeholders. We will adopt an iterative development methodology; this should not be considered as a fall-back option to correct a poor design, but a first-choice option, which is increasingly appreciated in the development of complex systems. Moreover, it is the only choice possible in the absence of prior and detailed knowledge of the context in which one is operating. At least one third of the learning scenarios listed below are the product of a collaboration that started in the first module of the first phase of Pilot Cycle 1 in Italy (May–June 2018). The teachers involved are willing to continue with the second module.

Most of them have agreed to be involved as mentors in the second cycle (winter–spring 2019), where their role will be to guide colleagues' who are joining the Up2U project[4].

The next step is up to the teachers' community. We are planning to mentor our teachers in designing viable learning scenarios and to implement them within different contexts of interaction with a variety of learning providers (macro scenarios).

In Table 3.2, for each scenario we provide a short description, a reference to the pedagogical method(s) applied in it and its subject area(s); moreover, we tentatively characterise the scenario, with a rough "yes/no" value, referring to its ability to allow collection of data for analytics. Two of the scenarios are described with some degree of detail in the next section and a few others in Appendix B.

#	Pedagogical Methods applied	Short description	Subjects	LA
Category 1: Classroom-based interaction				
1.1	Project-Based Interaction Scenarios	Mic, attending his school in Brussels, remembers his experience in a summer camp and produces a full Learning Path on the climate change challenge; this will be used by his teacher in classroom.	Natural Science, Geology, Ecology, Geography, Political Sciences	Y
1.2	Flipped Classroom Scenarios	A classroom is engaged by a teacher in a Language Course for immigrants.	Language, Sociology, Pedagogy	Y
1.3	Trialogical Scenarios in classroom	Teacher starts a trialogic based Learning Unit where learners are requested to produce artefacts describing their experience in Sustainability Education.	Geography, Ecology. Natural Science	Y
1.4	Flipped Classroom Scenarios	Teacher proposes a Learning Unit dealing with physics and geometry to let a classroom experiment with drones in Cultural Heritage.	Physics, Geometry, Art, History and Heritage	Y
1.5	Flipped Classroom Scenarios	Reusing filmed material to connect big history with local history.	History, Media literacy, Digital literacy	Y
1.6	Place-Based Scenarios	Flavia proposes her project based on mapping walking routes in her region.	Geography, Digital Media, History, Ecology	Y
1.7	Project Based Interaction Scenarios	Introductory course providing the learner with basic skills to: analyse and defend one's thoughts; read and write argumentative texts; make speeches transparent and logically consistent; pick up errors and	Philosophy, Logic, Language, Media literacy	Y

[4] Some of the teachers involved in the first stage of piloting agreed with the SMC on the follow-up benefit that these activities could have in proposing a number of Erasmus projects in March 2019; in this case we will be able to fund schools in experimenting and thoroughly practicing different activities designed in the Up2U NGDLE.

#	Pedagogical Methods applied	Short description	Subjects	LA
		sophistry; evaluate news and claims found on the web and other media.		
1.8	Flipped Classroom Scenarios Project-Based Interaction Scenarios Trialogical Scenarios in classroom	This course represents a part of an English Culture and Language curriculum: the Romantic Literary Movement. The learner acquires theoretical knowledge through OERs and videos consultation, then discusses and applies his knowledge to critically analyse poetic texts and make connections through history, culture and literature, enhancing ICT and linguistic competencies while developing transversal skills.	Literature and Language, History, Arts	Y
1.9	Project-Based Interaction Scenarios Trialogical Scenarios in classroom	Ancient Greek philosophers presented with the language of publicity.	Philosophy, Communication and Media science	Y
Category 2: Internet-based interaction				
2.9	Project-Based Interaction Scenarios	A learner enters the Up2U ecosystem and proposes a Resource Mapping campaign in the context of the OpenStreetMap movement.	Geography, Digital Media, Crowdsourcing	Y
2.10	Project-Based Interaction Scenarios	A learner meets Up2U via web and proposes to become a "champion" in citizenship and language education for immigrants.	Language and Citizenship education	Y
Category 3: Non-formal institution-based interaction				
3.11		Climate Change KIC organises a basic course on Sustainability Education.	Ecology	Y
3.12		Planet2084 organises a stage hosting experts together with classrooms to operate an online desk for their Webzine.	Ecology, Digital Media	N
3.11		Seashepherd (ONG) proposes a campaign to monitor and check plastic waste in sea shores; the organisation uses Up2U as NGDLE to enter in secondary schools.	Ecology, Geography	Y
3.12		AICA (a national professional association of computer scientists) proposes an educational campaign on Digital Culture based on the usage of a light and easy access to Up2U ecosystem.	Digital Culture, Digital Literacy, Computer Science	N

#	Pedagogical Methods applied	Short description	Subjects	LA
Category 4: Personal Project-Based (or informal) Scenarios				
4.16	Project-Based Interaction Scenario	A teacher manages an organisation to collect and share best practices on Special Needs.	Pedagogy, Psychology	Y
4.15	Project-Based Interaction Scenario	A.C., who completed her school path with brilliant results, overcoming her dyslexia syndrome, wants to engage to support others with dyslexia syndrome.	Pedagogy, Psychology	N
4.16	Project-Based Interaction Scenario Place-Based Scenario	A street art enthusiast creates a path to raise people's awareness of the street art movement, to let them experience the artistic creation process and to create a network interested in regeneration of urban areas through street art.	Urban design	N

Table 3.2: Summary of learning scenarios (different Interaction Models in Up2U ecosystem)

3.5 Two Examples of Learning Scenarios

In these subsections, both informal and more formal descriptions of learning scenarios follow the suggestions found in "Using the IMS LD Standard to Describe Learning Designs", by Rob Koper and Yongwu Miao (Open University of the Netherlands).

For each scenario, the informal description includes

- Title and summary.
- Information on pedagogy, context and objectives.
- A list of the different roles.
- Information on types of learning content and of learning services/tools.
- Information on collaborative activities and on the activity workflow.

Each phase in the workflow is described by providing:

- A summary of sub-phases, materials and setting.
- A list of activities and interactions with an indication of the roles involved.
- Information on the fact that some or all of the activities within that phase could be traced to collect data for analytics; also in this case, the value is a provisional "yes/no", to be refined after a better evaluation; it could be replaced with a list of the xAPI statements that could be generated and/or with the xAPI recipes that could apply.

The more formal models that we provide for some of the proposed scenarios are a variant of the UML Activity diagrams. They lack most of the textual information and can be interpreted only in

combination with the associated informal description. We report here only two learning scenarios, with additional examples included in Appendix B.

3.5.1 Learning Scenario 1.5: Reusing Historical Films

Providers of this scenario are Giovanni Lariccia, Andrea Cevenini during the Italian pilot.

Title	LS 1.5 Reusing historical films and video interviews of testimonials to connect big history and local history		
Pedagogy /type of learning:	A Project-Based Learning Scenario		
Description/context:	This course is an example representing a part of a curriculum on collecting and evaluating historical documents and video communication. It is assumed that the learners will have short courses to become familiar with filmed historical documents prior to taking this course. In this course the learners in small groups (4 people) help each other to classify filmed documents and to make video interviews with old people. The tutor is involved in the process as well.		
Learning objectives:	The objective of this course is that the learner acquires competencies about collecting and historical filmed material available in an institutional public film archive. The learners at the end of the project will be able to organise historical films in a database, summarise and comment on relevant ones and to construct learning paths for future learners.		
Roles	The tutor and the learner		
Different types of learning content used:	Web pages which contain content about various documents on big history and local history in the period 1930 - 1950. CommonSpaces will be used to catalogue filmed materials.		
Different types of learning services/ facilities/tools used	Up2U ecosystem, CommonSpaces		
Different types of collaborative activities:	The learners organised in groups of four will try to interview old people in the local environment who have been witnessing or even participating in the historical events narrated by the films		
Learning activity workflow (how actors/content/services interact):	The course is organised in six phases:		
	Phase	Description of activities (or pattern)	Tracking
	1: Registration	Each learner registers to a formative assessment process by providing personal information and by choosing one item from a list of learning theories (including behaviourism, cognitivism, and constructivism) as her/his specific learning	Y

Title	LS 1.5 Reusing historical films and video interviews of testimonials to connect big history and local history		
		interest. When all learners have finished registration, this phase is completed.	
	2: Provision with Evidence	Each learner is asked to view predefined historical filmed materials about the history in Italy from 1930 to 1950. All the films will be selected from a collection of more than 300 historical films maintained by Istituto Luce. Each learner is required to write a critical summary of the film he has viewed, referring to big history as it is presented by history books and small history drawn by memories of his/her family. The tutor monitors the state of learners' work and can decide to terminate this phase.	Y
	3: Assessment	Each learner reviews the document of her/his peer by commenting on and grading the article. After the peer's review is finished, the tutor will review the article with the consideration of the peer's review by commenting on and grading the article as well.	Y
	4: Follow-up activities on the historical films	When the tutor has finished the review of the article of a learner, the comments of both the peer and the tutor are visible for learners. The final score of a learner is calculated in a way that tutor's weight is 0.6 and the weight of peer students is 0.4. According to the final score, an appropriate follow-up learning activity will be arranged for the learner.	Y
	5. Interviews	Each pair of learners is required to plan and carry out a couple of interviews with old people	Y
	6. Learning paths	The historical documents and the interviews will be inserted in a learning path prepared by the learners	Y

Table 3.3: Learning scenario: reusing historical films

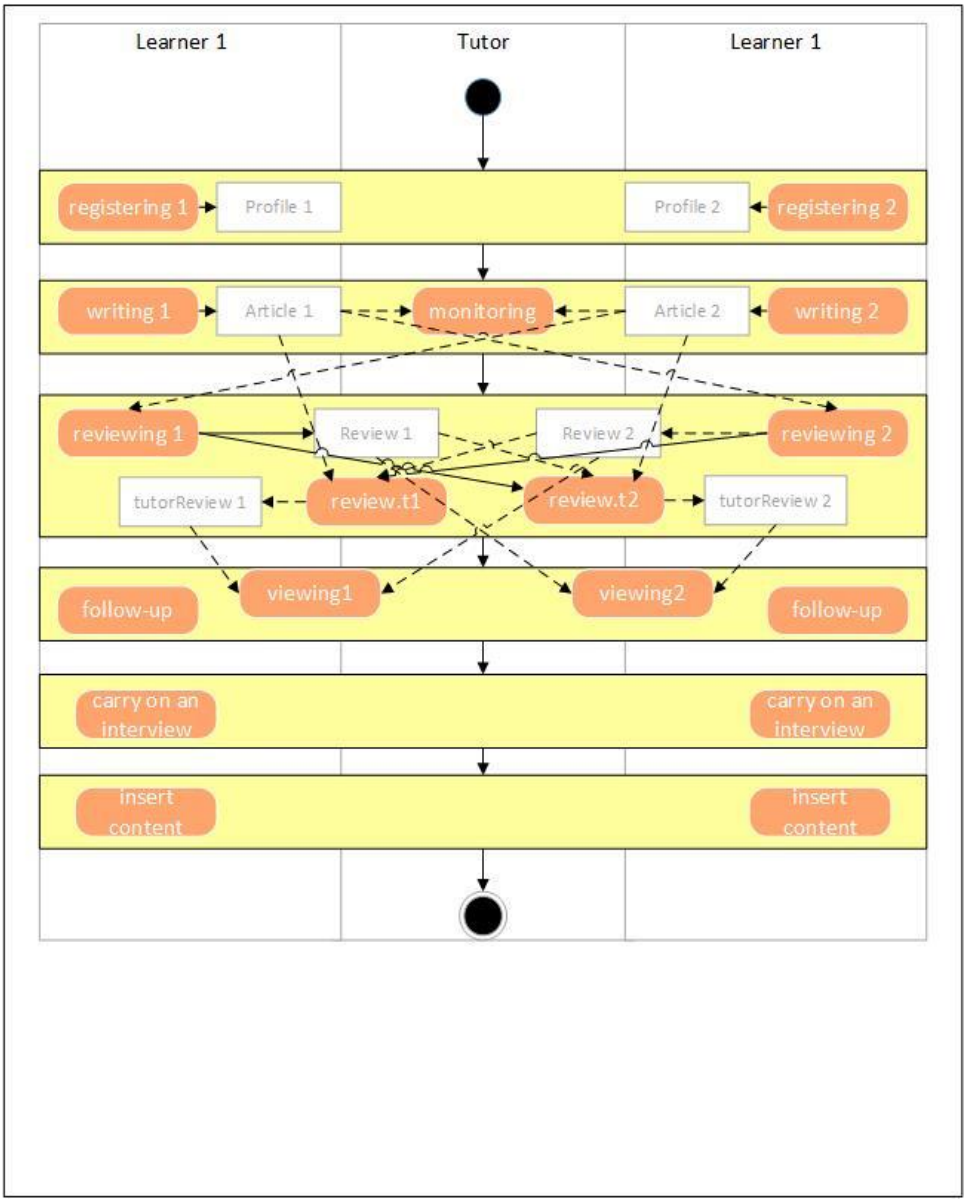

Figure 3.1: The UML graphic rendering of Learning Scenario 1.5

3.5.2 Learning Scenario LS 1.7: Introduction to Critical Thinking

We have included this example of a learning scenario that focuses on developing critical thinking, in view of the high priority given to this skill by Up2U survey participants. As the survey results reported in Section 2 show, university lecturers viewed critical reasoning and the ability to critically analyse texts as by far the most important skills required at university level. Similarly, high school teachers viewed "evaluating the validity and credibility of information" as the area showing the greatest gap, where most attention needs to be focused.

This learning scenario was inspired by the book *Manuale di educazione al pensiero critico*, by Francesco Piro (University of Salerno), and by a presentation by Antonella Poce and Francesco Agrusti (University of Rome 3).

Title	LS 1.7 Introduction to critical thinking		
Pedagogy /type of learning:	FC - Flipped classroom PBL - Project based learning		
Description/context:	This is an introductory course providing the learner with basic skills to: analyse and defend one's thoughts; read and write argumentative texts; make speeches transparent and logically consistent; pick up errors and sophistry; evaluate news and claims found on the web and other media		
Learning objectives:	General transversal skills: Critical Thinking and Problem Solving, Information, Media and Technology Literacy, Communication and Collaboration Specific/domain skills: text analysis, argumentation, reasoning fallacies		
Roles	Teacher, learner, tutor		
Different types of learning content used:	Audio and video presentations; texts of classical authors and other OERs; recorded audio-video dialogs; authored text materials		
Different types of learning services/ facilities/tools used	A platform for uploading educational materials to be shared, for having asynchronous discussions, for having audio-video meetings A set of (possibly online) tools to perform basic operations on text and lexicon An online tool for test/questionnaire delivery: open questions and main types of closed questions Tools to make audio-video recording and replay of live argumentations		
Different types of collaborative activities:	Live argumentation Asynchronous communication and document sharing Group work using text analysis tools Group reporting		
Learning activity workflow	How actors/content/services interact)		Tracking
Phase 1: Introduction, motivations, and knowledge acquisition:	Historical excursus; exposure to texts by classical philosophers and thinkers	Teacher and learners meet in person: teacher briefly presents objectives and structure of the course; teacher assigns different reading tasks to each learner. Learner reads assigned text and searches related materials on the web. Tutor helps learner online. Teacher and learners meet: each learner reports on his/her reading and on thoughts arising from it and shares a written report with teacher and other learners.	Y
Phase 2: Knowledge acquisition and application:	From text to enunciation; what are enunciations; compound enunciations; how to analyse	Learners read a written (and/or hear/watch a recorded audio/video) dialog introducing the subject and providing specific motivations.	Y

Title	LS 1.7 Introduction to critical thinking		
	speeches; argumentation and discourse	Learners read course materials presenting the subject in detail. All actors interact through asynchronous discussion tool. Tutor helps learners to overcome problems and find more materials. Learner fills in a questionnaire. Teacher and learners meet in person or through an audio/video tool: they discuss doubts and questionnaire outputs; teacher moderates an on-the-fly argumentation exercise.	
Phase 3: Knowledge acquisition and application:	Types of inference used in argumentation: deduction, induction, abduction; reasoning patterns and their counterparts in the text structure	(as previous phase)	Y
Phase 4: Knowledge acquisition and application:	Why are we deceiving ourselves? typical fallacies deriving from imprecision of language, improper use of inference rules, psychological biases, wrong probabilistic concepts	(as previous phase)	Y
Phase 5: Knowledge acquisition and application:	Basic operations and strategies for text analysis: text/corpus preparation, extraction of lexicon, grammatical tagging of the text based on morphological and phraseological vocabularies, counts and frequencies,	Teacher and learners meet in person or through an audio/video tool: teacher introduces the subject; teacher and tutor demonstrate the use of available analysis tools for text analysis; learners form small groups (2-3 people); teacher assigns to groups different text analysis tasks; teacher assigns an individual reporting task to each learner. Learner installs text analysis local tools or access online tools. Tutor supports learners online. Learners in a group meet in person or online to perform the assigned task; they collect	Y

Title	LS 1.7 Introduction to critical thinking		
	finding patterns in text.	results, write a report and share it with teacher and other learners. Each learner writes a final report on his/her learning experience, according to a common template (open questions review).	
Phase 6: Assessment:	Revision of critical reading and critical writing exercises; plenary debate; conclusions	Teacher and learners meet in person; a learner from each group illustrates its report on work done in previous phase; other learners in the group add comments; teacher discusses selected examples to identify possible relationships between text analysis results and type of text/argumentation; teacher presents some ideas on how attending the course could have improved/modified the way learners write and argument, by comparing, with text analysis methods, reports they produced in phases 1 and 5. Final semi-serious argumentation session moderated by teacher.	Y

Table 3.4: Learning scenario: introduction to critical thinking

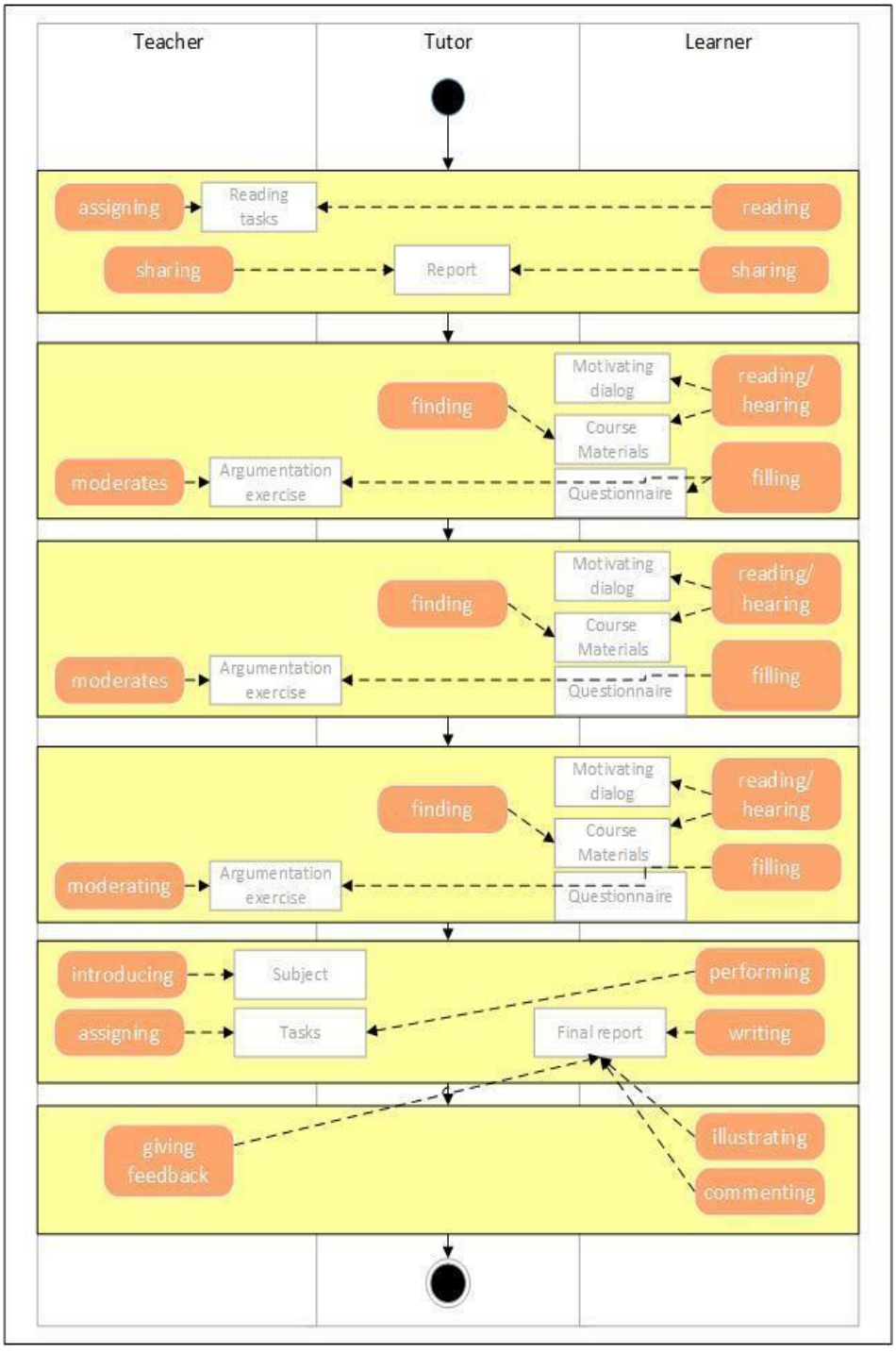

Figure 3.2: Description of LS 1.7 using a UML Activity diagram

3.6 An Analytical Description of the Actors, User Roles, Actions and Activities in Up2U Learning Analytics Context

This section describes a general framework to be integrated into the Up2U ecosystem (define work hypotheses, discuss hypotheses with teachers and test these hypotheses within different communities of learners).

The technology team will provide the learning communities with a learning record store (LRS) where records of experiences (xAPI statements) should be collected when a learner is performing certain types of actions.

From the DoA: [D5.2] will provide an initial analytical description of the user roles, actions, social interactions, automated mediated actions.

3.6.1 Actions and activities

Here we use the term "action" in a generic way, regardless of the granularity level. A more detailed conceptual model could structure user activities in hierarchical layers as follows [Kuuttii]:

- Activity: a coordinated set of actions by a single user or a group, following a certain strategy.
- Action: a sequence of consecutive operations by a single user within a timespan, for reaching a certain goal.
- Operation: an atomic action by a single user that one cannot or does not want to analyse in more detail.

Tracing could happen, in a more or less automatic mode, using xAPI or other standards, at each granularity level: if tracing happens at the level of operations, analytics could exploit known patterns to identify actions; similarly, if the tracing happens at the level of actions, analytics could exploit known patterns (say, "recipes") to identify activities.

The LRS will register actions that (implicitly) follow certain patterns as these are used and activated in different learning contexts. It is an important task of the learning designer and of the analytics designer to define those patterns or recipes and to refer to them in a complete description of a learning scenario: activities should be modelled by using labels identifying the granularity level of the actions and of the associated traces (such as xAPI statement).

3.6.2 Roles

The term "role" is a tricky one, referring more to relationships then to intrinsic properties of subjects. A role can designate the place that an agent occupies in the society, in a community or in a specific situation/activity. In the first two cases, a role is quite static; according to the English Wikipedia, "A role (or social role) is a set of connected behaviours, rights, obligations, beliefs, and norms as

conceptualised by people in a social situation". In specific situations or activities, the mapping between agents and roles can be much more dynamic.

Very often the above distinction, between socially assigned roles and situational roles, is not sufficiently clear.

For example, in "Roles for Students throughout the Education System" [Soundout], you can find the following list of roles: Learners, Facilitators, Organisers, Advisors, Experts, Advocates, Evaluators, Lobbyists, Planners, Researchers, Thought Leaders, Designers, Policy Makers, Activity Leaders, Trainers, Politicians, Mentors, Paid Staff, Grant-Makers, Decision-Makers. In the more restricted field of certification, you can find roles such as Certification Authority, Testing Provider, Certification Applicant. In the field of courseware development, you can find roles such as Curriculum Designer and Instructional Designer.

Learning Design (namely IMS-LD) handles roles in a very general way; only the abstract (generic) roles Learner and Staff are pre-declared; more specific roles can be declared at the institution level: for example, Student could be a specialisation of "Learner". But it seems that roles have a formal function: they have mainly a local function for specifying the occurrence of the same actors in multiple coordinated activities.

Likewise, in the sample scenarios that we tried to describe in an informal way within Up2U, we listed activities referring to a small number of roles: Learner, Peer, Teacher, Tutor, Mapper. The role labels, rather than referring to a standard (globally agreed) set of properties for the actors, are used to facilitate the identification and distinction of different actors within the same scenario or activity; for certain roles we even used labels such as Learner 1 and Learner 2.

In the specification of xAPI statements, it seems that roles do not appear at all. Some people who asked how to treat roles got no clear answers. We think that:

- In so far as a role is intended to refer to a typical profile of the "actor", its semantics is incorporated in the action, mainly by specialising its "verb" component.
- There is no need for a role to identify the "actor", since this is already fully identified by its own attributes (ID, name, email, etc.). Remember that xAPI was born for tracing real activities, even if it can provide useful hints also for learning design.

Beyond the general considerations set out above, in Up2U we need to consider the notion of role also in a more pragmatic way, so that tool developers and tool users have some reference terminology to orient themselves. We can compile a provisional list of roles, by merging those supported by tools already in use and others that we can draw from known learning scenarios, including those that were described in previous sections. This list could be revised later and the semantics of individual roles better defined also with reference to specific sets of interaction types.

Roles related to navigation of web sites and access to web applications:

- Guest – can view public content but, as a rule, cannot participate or contribute
- Authenticated user – a user that has logged in to an application being recognised by some authentication authority
- Administrator – can create user groups and grant other roles

Standard roles in formal learning settings:

- Course creator – can create courses
- Teacher – can manage and add content to courses
- Student – can access and participate in courses

Other roles typical of non-formal and informal learning situations:

- Learner – this is possibly the most informal role
- Tutor – see the Glossary
- Mentor – see the Glossary
- Mentee – see the Glossary

Roles related to group work and content sharing (intranets, social networks and content management systems):

- Member – can participate in group activity
- Supervisor – can accept/reject applications for membership, enforce rules, etc.
- Editor – can contribute and/or modify contents in the content space shared by group members
- Revisor/Moderator – controls the publication state of member contributions

3.6.3 Interactions

Learning and teaching are intrinsically social processes, in large part based on explicit interactions, although the individual activity of reflection is also very important in them. It is not particularly important to distinguish between technology-mediated interactions and other ones: in the present times, the transition between them appears to be seamless.

In analysing interactions and in trying to classify and model them, it is useful to consider the layered, hierarchical model that has been proposed above for tasks and activities: in brief, activities are strategy-driven sets of targeted individual actions, which in turn are made up of sequences of atomic operations.

Interactions can be identified at each hierarchical level; the most interesting ones for us are interactions between actors, happening at a high level; at lower levels, direct interactions appear to happen between an actor and a device or an artefact.

In the Up2U context, we are not focusing on basic principles and mechanisms of interaction with technological devices: specialised research centres, such as the Media Laboratory at MIT, and research centres of global companies such as Apple, Google and Microsoft, will always be a few miles ahead of what we can conceive and propose (mouse, touch screen and voice input/output are just a few historical examples).

Moreover, supporting smart and effective atomic interactions with technology devices, especially at the input/output levels, more than a task of educational environments is a task of operating systems; in this term we include also web browsers, whose functionality, as far as the UI is concerned, is more

and more closely interlinked with that of the traditional operating system; in some sense, modern browsers are becoming the UI layer of cloud-based operating systems.

Different types of interactions could be analysed with reference to the pedagogical methodologies (or theories) inspiring educational scenarios. But, possibly, it is more practical to consider them in relation to more simple and traditional classifications of learning types: learning by being told, by seeing (and imitating), by doing (e.g. producing an artefact), by discussing, and so on.

For example, the widespread use of video in education, especially in informal learning, can be explained by the fact that it supports both learning by being told and learning by seeing, although it may not be ideal for inviting reflection; also, it can favour passivity, since it was born as a poorly interactive medium. However, its interactivity can be improved by providing tools to manipulate the original version of a video in a remixing perspective, by adding subtitles and translations, extracting segments, and using them in articulated learning paths; the H5P technology can help allow virtual manipulation of the video sequences and the insertion of interactivity.

More generally, educational environments, such as the Up2U ecosystem, should promote principled uses of interaction technologies. For example, it has been observed that people, young people and students in particular, are often confused by the overwhelming quantity of the information available online, and especially by its fragmentation [Roncaglia]. Interaction helping to recompose information and knowledge fragments in meaningful structures should be favoured. In this respect, discussion forums, threaded discussions, thematic blogs and other user-generated content (UGC) allowing nested comments, should be given adequate attention: this kind of asynchronous communication, in the form of Usenet “newsgroups” and of a variety of “bulletin boards” has been, at the dawn of the Internet, together with the email, at base of its success; it is still an essential ingredient of any environment supporting group work and collaborative learning. Up2U’s PD will address these issues and will cope with the changes needed in teachers’ role and competencies.

One could object that most social networks provide similar functionality, with appealing features that cannot be matched by, say, Moodle or CommonSpaces. However, their strength is based more on their monopoly in the collection and aggregation of personal data than on the intrinsic quality of their technology. This discourse could be broadened by considering the current debate on the control of personal data, which recently has been enlivened by the news on Tim Berners-Lee’s latest initiative [WhatIsSolid]. In any case, the challenge for Up2U is to be able to create a meaningful context for the use of both new and mature interaction technologies, where the community and its objectives contribute to qualify the offer.

Teachers, supported by the team of mentors, will drive the further definition of data worth collecting while tracking the execution (JOURNEY) of specific sections of a learning scenario from a learner.

Parts of this Deliverable will provide a “Teachers’ Guide for Learning Analytics Applications”.

3.6.4 Social interactions, learning analytics and analytics dashboards

Above in this document we have set out to provide some guidelines to interact with the teachers’ community in building an experimental framework in which elements of learning analytics can be included. Then, we outlined some general considerations and described learning scenarios that may

represent use cases for the pedagogical use of technology and for the collection of data on learners' activity.

We have also assumed that such data, whatever its type and sources, will preferably be collected in a single xAPI repository. The current prototypical NGDLE integrates an xAPI LRS, Learning Locker, that in its basic open source configuration already includes an "analytics dashboard" with considerable filtering and data aggregation capabilities.

While Learning Locker, within the open and flexible architecture of the NGDLE, could be replaced or complemented in the future by other implementations of the LRS concept, and even the choice of the xAPI protocol could be called into question, for now we can suggest the following lines of action:

- Using the analytics dashboard of the currently available LRS, and a small sample of data, the teachers should acquire a minimum degree of familiarity with this type of tool.
- With the collaboration of teachers, we should design one or more xAPI profiles, starting from available examples – some of which are given in Appendix D – and from a repertoire of interaction types, mostly social interactions.
- Based on the experience gained using the analytics dashboard coming with the LRS, we should develop and evaluate one or more additional, less generic, dashboards: possibly less powerful but more user-friendly.

We list below a provisional repertoire of the learning interactions that the NGDLE should allow to be traced in order to provide teachers, learners and other stakeholders with a first level of awareness of which data can be collected and which types of indications can be drawn from them:

- Threaded discussion: comment on any online content, open a topic in a forum (post the opening message), reply to a post at the proper nesting level, manage the forum (publish/unpublish posts, call for fairness).
- Organisation of a workgroup: create (propose / open) a workgroup or project, apply to a workgroup, manage workgroup membership (accept/reject applications; delegate supervision), send a message to the members of a workgroup, create and manage nested shared folders.
- Production/sharing of simple contents/artefacts: post to a forum (see above), create and share bookmarks and webpage reviews, create and share bibliographic references according to standard formats, upload a document in a standard/common format, add a page to a wiki, add an article to a blog.
- Online meeting: schedule a call and issue invitations, moderate/manage a call, enable and disable own microphone and camera, request and use shared screen control.
- Production of advanced artefacts: create the structure of an online course or of an online learning path, add a section/subsection to a course, add a subtree/node to a learning path, record a frontal lesson or an audio/video interview, subtitle a video, cut and edit a video, animate a video by linking other contents, create a personal portfolio.
- Mentoring programme: create and manage a register of mentors, volunteer as a mentor, ask for mentoring support, match mentee with mentor, draw up the contract/plan of a mentoring relationship, participate in a mentoring relationship as the mentor, participate in a mentoring relationship as the mentee.

Most of the above interactions are already supported at some level by components of the NGDLE; what is needed is to equip the latter (that is, its components) with the ability to send statements to the LRS with the right granularity – possibly introducing some parameters to adjust said granularity – within a general framework to be defined, through xAPI recipes and profiles, with the collaboration of the teachers and other stakeholders.

In Appendix E we provide a few examples of interactions that the NGDLE could address to support the testing of some learning analytics in informal learning contexts.

For some types of interactions, such as the construction and development of artefacts based on audio and video processing, it might not be possible to devise a dedicated tool directly generating analytics data tracking behaviour; some simple experiments could be done – in collaboration with the teachers themselves – using a technology such as H5P, which allows you to flexibly plug in, inside educational content, elements of interactivity and of tracking at a fine level of granularity.

More generally, next iterations in the extension and consolidation of the NLGDE, and in the design of the pilots for the teachers, could consider the best recommendations that we can find in the literature on learning analytics dashboards. For example, Verbert et al [Verbert] argue that the following types of data may be usefully incorporated into a dashboard (besides results of assessment tests):

- Artefacts produced by learners, including blog posts, shared documents and software.
- Social interaction, including speech in face-to-face group work, blog comments, Twitter or discussion forum interactions.
- Resource use, which can include consultation of documents (manuals, web pages, slides) and views of videos.
- Time spent, which can be useful for teachers to identify students at risk and for students to compare their own efforts with those of their peers.

The above section has specified a number of skills that Up2U's PD will focus on in our planned "Teachers' Guide for Learning Analytics Applications". The topic of what sort of training will provide teachers with the additional knowledge and skills they need for integrating new technologies into their daily teaching practice will be covered in the next section.

4 Teachers and Students: Virtual Ecosystem Meets Real People

This section describes Action #3**,** which prepares teachers and students for using the ecosystem to promote the target skills through the identified learning models. It covers the following topics:

- Getting teachers ready to bridge the gap.
- Educational communities and Up2U.

4.1 Getting Teachers Ready to Bridge the Gap

Our main challenge is to reach schools at classroom level and to have a real impact on students' everyday life. Success in this objective will ultimately depend on the direct help and involvement of teachers as subject-matter expert professionals and practitioners. For this reason, we have planned a series of training activities, named Continuing Professional Development (CPD), to stress that teachers are professionals whom we want to involve on a continuing basis, working with them to develop new, useful inputs for their teaching activities. We will achieve this by emphasising the potential strengths of different teaching models and technological tools, illustrating which factors to consider in the decision-making process, and demonstrating best practices for developing Up2U skills in the classroom within specific subject areas.

Unfortunately, there is a general tendency to structure teachers' professional development paths as "courses" in which the theoretical and methodological importance of technologies is not linked to active, practical learning. As a result, teachers often learn about software as a conceptual system separate from their real-world issues, or about applications via "how-to" guides and lectures, gaining only passive examples of ways to use technology. Neither of these approaches provide the necessary parallel reflection given by the "learning-by-doing" apprentice style, which is the only one that enables teachers to fully understand, through experience, a number of important practice-based considerations:

- How, why and when to introduce technology, based on contingencies such as the subject area, student numbers, levels of students' prior knowledge and learning objectives.
- The potential of technological tools to add value, as well as their possible constraints.
- Ways in which technology can support students' engagement and their development of crucial societal competencies.

Introducing technologies is not, of course, sufficient on its own to positively influence educational practices. Rather, technology should be used as a tool to mediate the construction of a student's collaborative learning. The next section will answer the question of what type of professional

development (PD) is needed in order to provide teachers with the additional knowledge and skills they need for effective integration of new technologies into their daily teaching practice.

4.1.1 Design Principles of the Trialogical Learning Approach (TLA)

To compensate for the many limitations that often characterise teachers' training, our PD learning path is based on the Trialogical Learning Approach (TLA – see Section 2), which we consider to be an effective and appropriate theoretical framework on which to build teachers' training. This is because TLA integrates many previous theoretical aspects of project-based learning, collaborative learning, knowledge building and active participation, and development of core transversal skills. Table 4.1 summarises TLA's design principles.

TLA Design Principle	Strategies and activities of the training path
DP1 Organising activities around shared "objects"	Teachers/learners required to collaboratively build a final artefact: the pedagogical scenario to implement Up2U tools and pedagogy in participants' own classroom
DP2 Supporting interaction between personal and social levels	Personal and collective level supported as follows: a) From personal reading to the description of individual practices, from appropriate source searching to learning-group discussions; b) Role-taking: learners assuming specific tasks and responsibility to reinforce positive interdependence
DP3 Fostering long-term processes of knowledge advancement	Iterative cycles of knowledge work: from online discussions to concrete products (such as conceptual maps, critical reports, best practice descriptions) which the groups comment on to provide constructive feedbacks to their colleagues
DP4 Emphasising development through transformation and reflection on various forms of knowledge and practice	Many teaching techniques and knowledge formats: lectures, peer discussion, comparison with theories, videos; from theoretical to practical knowledge through the final scenario; critical reflection about the course promoted through the final questionnaire and the focus-group discussion
DP5 Cross fertilisation of various knowledge practices across communities and institutions	Designing a pedagogical scenario as a bridge between university, theoretical approaches and school; work-group and discussions with colleagues of related and/or different disciplines; notes/feedback by expert and professor
DP6 Providing a flexible, incremental, accessible set of tools for mediation	e.g. Moodle, SeLCont, PuMuKIT, H5P, CernBox, KnockPlock
DP7 Providing an incremental, accessible set of logic and tools for in itinere self-assessment and qualified production of data for learning analytics[5]	Learning Locker, Watershed, ClassChart, Curatr, CommonSpaces and integrated language analytics tools are further tools and techniques to experiment with and to integrate after a selection process carried out with

[5] This point, DP7, was added by us to the traditional "Trialogical" Learning Approach List of Design Principles

TLA Design Principle	Strategies and activities of the training path
	teachers in the second, third and further cycles of the pilot

Table 4.1: TLA design principles

The table serves both as a conceptual framework and as a general scheme to drive future activities. A more detailed description of the teachers' learning path is analysed in Deliverables D5.3 and D7.1.

The conceptual framework of individual learning assessment, and the framework in which "Big Data" could be provided, aggregated and processed to analyse the impact of the ecosystem (or the NGDLE) on each national educational subsystem, will be integrated and tested as the last step of the integration of different country systems within Up2U project ecosystem.

4.1.2 Learning Analytics for Self-Assessment

Pedagogists and technology-focused researchers involved in the project have been discussing what logic should be provided to teachers and to their classes, to better understand, experiment with and apply the emergent technological opportunities arising from the definition of the xAPI protocol and from the first set of products and services available within the Up2U ecosystem to exploit the potential that comes with them.

Together, we have been watching some specifically prepared demos of products that are available to be integrated in the Up2U ecosystem.

Some general principles have been collected that will be the basis of our collaboration with teachers:

- Person-centred vs. institution-centred method
  - From our discussions, it emerged that to avoid critical issues of privacy and management of sensitive information, giving learners (students as well as mentors and teachers in Professional Development) direct responsibility for managing their learning data would be a useful addition to institutional data management.
  - Personal responsibility would also act as a valid incentive for learners to record and store each and any new progress in their "learning path". The interested subject could: enable several additional data sources, mostly related to informal or non-formal learning; within some limits, control who can access the data collected; and produce analytics views of personal interest.
  - This would also result in early personal management of a Personal Learner Portfolio/Curriculum, something that is also a benefit in relation to the transition to Higher Education.

- General criteria for introducing elements of learning analytics
  - The central open source learning record store (LRS) service, to be installed (and integrated) in the Up2U ecosystem, would be a step in the direction of a secure, non-profit organisation that would act as an interoperable, free (or freemium) register of learning experiences.

- It would not be valuable if we limited our approach by collecting xAPI data only from a single LMS, since one of the main goals of the xAPI protocol is to bridge the gap between formal and informal learning experiences.
- It would be better to prepare only a few, standard activity templates (matching xAPI "recipes") that can serve as an easy introduction to the whole xAPI framework.
- It would not make sense to prepare in advance many activity templates before the demand progressively emerges from real students / mentors / teachers. If we did, we would then have to select those among them that are really requested by "the market".

- What to track about an individual (or group) learning process
  - The job of identifying types of activity worth tracking would be given to the teachers' / mentors' community, although in Section 3 we have already started making a list, based on the analysis of the literature and on preliminary indications from the first pilots.
  - A provisional list of examples that would be of interest both to perform as progress (or in-itinere) assessment for learners, and to provide anonymised data for later processing, is provided below. Most of the activity tracing could result from voluntary actions made by the learners; it is not appropriate here to state whether they could be implemented through web-browser plugins or a few dedicated web applications or by other means, but an effort should be made to integrate them within the Up2U ecosystem.
    - Tracking of web searches for information related to the execution of a given learning path, such as biographical data of the authors of a scientific contribution, paper or book.
    - Tracking of web exploration aimed to profile a geographical location cited in a learning path.
    - Tracking of visits to the web showcase of a museum collection where specific artworks are hosted.
    - Tracking of the process of searching for bibliographic data needed to prepare a written contribution, being performed either by a single learner, or by a working group[6].
    - Tracking of participation in a forum debate (number of reactions, type of reactions) in order to analyse the participation quality.
    - Tracking of TED Talks that were searched and watched as voluntary additional research into a given subject at the suggestion of the teacher.
    - YouTube video produced and / or viewed about a specific subject (interviews, debates, etc.).

4.2 Educational Communities and Up2U

National educational communities have been key players in Up2U from the start, even before the project was accepted and financed. Several schools signed a declaration of interest in the project that

[6] Many Citation Manager tools (some of them open source, some proprietary) are available. They tend to cover metadata extraction, storage and reuse for a variety of different types of content: scientific papers, journals, books, book sections, proceedings, reports, movies, patents, video interviews and simple websites. The activity of referencing a content item is highly automated and can be usefully tracked in its more meaningful nodes. For details see Appendix E.

was attached to the project itself. Their involvement has continued since then. The use of surveys was adopted to maximise the opportunity to interact with them, making it possible to implement a meaningful exchange between researchers and the teachers' community. It is important here to repeat a key concept: the involvement of our educational communities is fundamental. All partners know that the full involvement of teachers and learners is the only way to make the project fully sustainable. *Deliverable D8.1 Analysis of Up2U Ecosystem and Existing Business Models* [D8.1], in Section 2.1.3, defines the schools involved in the Up2U activities from the beginning as important stakeholders:

> *Up2U focuses on students preparing to enter university. Therefore, schools offering secondary education, that is the final grades before university, comprise an important stakeholder. For this reason, the solutions offered by the project are going to be tested from the beginning on a set of pilot schools across several different countries. [….]*

In the same document, schools are classified as promoters:

> *We have identified the EC and national governments together with secondary schools (represented by their direction and organisation board) as promoters, as they will have the greatest capacity of decision and impact on Up2U. Students, parents and teachers have a great interest in the project as its results can be very beneficial, but as they do not hold any decision-making power they are classed as defenders.*

Schools' main actors are students, teachers and principals. From the start the project focused on teachers' communities because:

- Teachers have an indisputable key role in educational communities.
- The change of paradigm started from the Bologna Process towards a student-centred educational system with the correlated challenges for teachers, in terms of pedagogical approaches.

  This process was originally intended for HE only, but nowadays high schools too are going in this direction, sometime performing even better than the HE institutions.

To encourage teachers' participation, we started to use dedicated social networks such as CommonSpaces[7], shown in Figure 4.1 below, where teachers as well as learners can meet within project-based communities, share ideas and create materials.

[7] The development of this social learning platform was financed by the Erasmus+ Project CommonS lead by Sapienza Roma University. It hosts teachers' communities after they attend the Continuing Professional Development activities as described in Deliverable D5.1. This platform is also open to teachers who did not attend any CPD, as well as to students. Its role is to help communities to grow on a nationality basis or on an interest basis. The link to visit the Up2U community is: https://www.commonspaces.eu/project/up2u/. It is going to be integral part of the Up2U ecosystem with the full implementation of the SSO system.

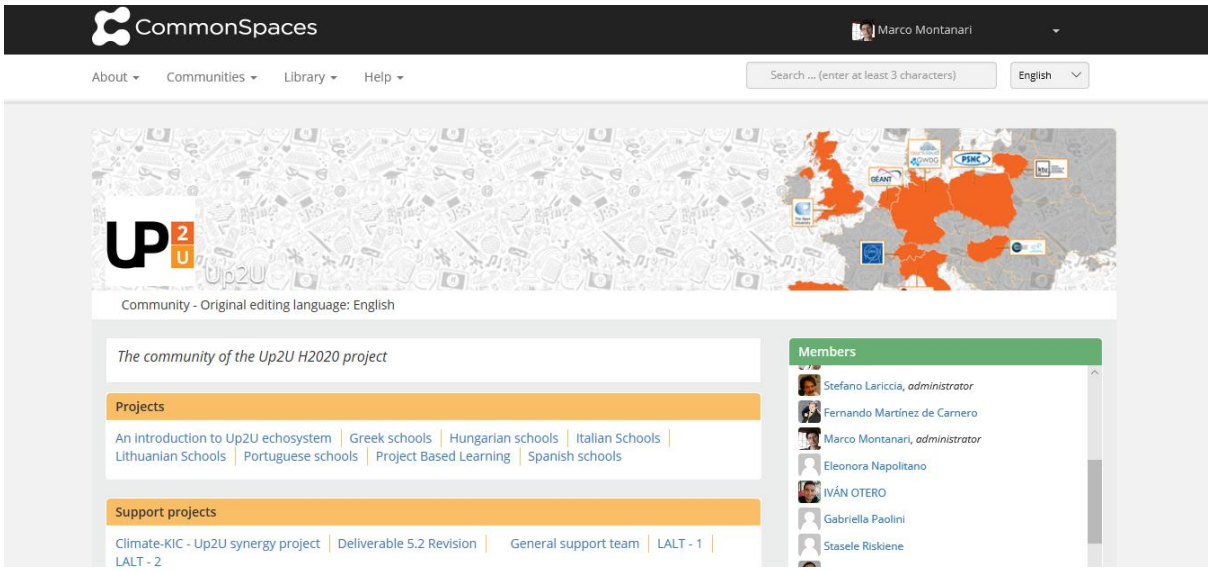

Figure 4.1: Up2U community on CommonSpaces platform

The interaction with teachers is leading us to a better understanding of each local context. We believe that this continuous interaction, even if it is a complexity factor, will improve the real impact of the project, keeping the development close to real needs of real school students and teachers.

For all these reasons we chose to focus on the local reality of the schools that asked to participate in this project from the beginning. In collaboration with WP7, we identified groups of schools in pilot countries and conducted in-depth surveys to identify their specific pedagogic needs, as described in Section 2. At the same time, we involved universities conducting similar surveys, to obtain a more complete view of what students need to succeed in their higher education studies.

Surveys were the first step to approaching schools and teachers and to building the first communities of learners in each pilot country. The scientific rationale of the results will be improved when feedback collection is implemented within the Up2U ecosystem (WP7 is working on this).

In the next section we address the need for a unifying assessment framework under the specific conditions of the interaction between formal educational environments (schools) and non-formal learning providers.

5 A Taxonomy of Interactions with External Agencies (Non-Formal Learning Providers)

This section describes Action #4, which addresses the need for a unifying assessment framework to harmonise formal education with non-formal learning providers. First, we outline a classification of different types of approach to a unified assessment framework that can be shared between formal educational agencies and non-formal learning agencies. Then we propose different logic – or technology strategies - and suggestions for an incentivisation policy. The section covers the following topics:

- Types of interaction with non-formal learning providers
- Generic learning macro-scenarios
- Type 1: an external agency certificates a learning program, schools recognise the certification

5.1 Types of Interaction with Non-Formal Learning Providers

As appraised in our pedagogical literature review, and as confirmed by the results of Up2U's surveys, it is quite commonly accepted that school systems must interact with non-formal agencies to improve their ability to adapt rapidly to changing needs. Many non-formal educational agencies are already working, in addition to formal educational systems, to meet the societal needs for a fast update in skills acquisition, as demanded by the new fluidity in the labour market in today's societies.

Formal educational systems in Europe are approaching this need differently; Up2U can act as a unifying model within this macro-scenario.

Type of recognition / interaction	Technological implementation
Recognition of external certifications	Via Open Badges, or via in-progress tracking based on learning analytics
Recognition of informal, self-directed activities	Via in-progress tracking based on learning analytics
Joint design of a non-formal learning experience suitable to be embedded into a formal curriculum (a set of paths plus assessment for each)	A formal educational institution collaborates with a non-formal agency in designing one or more learning scenarios and a number of Units of Study on the UP2U NGDLE; an Open Badge will be issued jointly from the 2 learning providers

Table 5.1: Types of interactions with external bodies

A list of these non-formal learning providing agencies is provided in Table 5.2 as an example of the types of bodies we are talking about[8].

Name / Acronyms	Description / Diffusion	Certification type / Mission	Number of schools / students reached
AICA (Italy) ECDL (EU) ICDL (W)	The Italian ECDL Foundation National Operator	ECDL – Security ECDL Open Badge recognition through CINECA Dissemination of digital culture in Italy according to the ICDL federation of organisations.	3,000,000 students (Italy)
Confucius Institute	HSK – Chinese language certification	The mission of the Confucius Institute is to disseminate and support Chinese language learning and teaching around the world	6,000,000 candidates in 2018 worldwide 460,000 registered students in 2016 516 Confucius Institutes worldwide 1076 Confucius Classrooms (worldwide), 80 schools in Italy
KIC Climate Change		The mission of the KIC Climate Change community is to reach teenagers (and schools) to spread a sound education about sustainability and mitigation and adaptation to climate change issues. They have a structured organisation capable of funding their campaigns; we have had a first virtual conference with their board.	440 students in summer school 2018
Reinforcement of Portuguese language teaching		Mission: teach Portuguese language to immigrants.	5,800 average trainees per year 2,500 certified trainees
The SELFIE Project		Mission: disseminate the use of a self-directed tool of	600,000 previewed

[8] With some of these agencies an interaction has already started and could be producing results in terms of schools federated into Up2U.

Name / Acronyms	Description / Diffusion	Certification type / Mission	Number of schools / students reached
		assessment/representation for Digital Skills and Competencies	students / teachers
Inclusão digital. (TIC Digital inclusion)		To stimulate spaces dedicated to providing access to occupational activities and to development of competencies; introductory courses to Information and Communication Technologies	30,000 TIC certificates 50,000 participants
Open Education Consortium		OEC focuses on those who create open educational resources (OERs) and those whose activities support the creation and dissemination of OER materials. OEC continues to work to promote various facets of open education by collaborating with institutions, governments, international organisations and individuals [OEC].	30,000 + learning modules 280+ organisations 40 countries 29 languages

Table 5.2: Examples of non-formal learning providing agencies

5.2 Generic Learning Macro-Scenarios

This section describes what kind of support we could provide to enable Up2U stakeholders (schools, principals, teachers, students) to better interact with non-formal agencies. It is an initial proposal that will be reviewed in the light of feedback from the learners' community; school principals, students and teachers will advise us on which mutual recognition policy would be most appropriate and how we can adapt our ecosystem to easily adapt to these needs.

Figure 5.1 below summarises graphically what kind of simultaneous workflows – or learning interaction macro-scenarios – take place in the process of learning.

We have represented the traditional – formal – institutions as a building, with pupils attending a frontal lecture with a teacher using a device and a projector (which is not at all the average situation, but it represents the trend). In a second box to the right of the first we have represented the "informal learning space", characterised by a diversity of situated learning: a learner with a GPS device, a learner interacting through a smartphone via a WiFi domestic connection; again, this picture does not represent the average situation but may be taken as the convergence point. In some European countries we have more than 60% of learners in this situation; in other cases the percentage is significantly below 50%. But we can agree that at the pace of the last decade, in few years we will have a clear majority of learners in this situation. A third box depicts the non-formal learning activity domain. This shows learners organised in cohorts, dealing with specific knowledge domains. All the interactions are mediated by clouds and servers of the Up2U NGDLE.

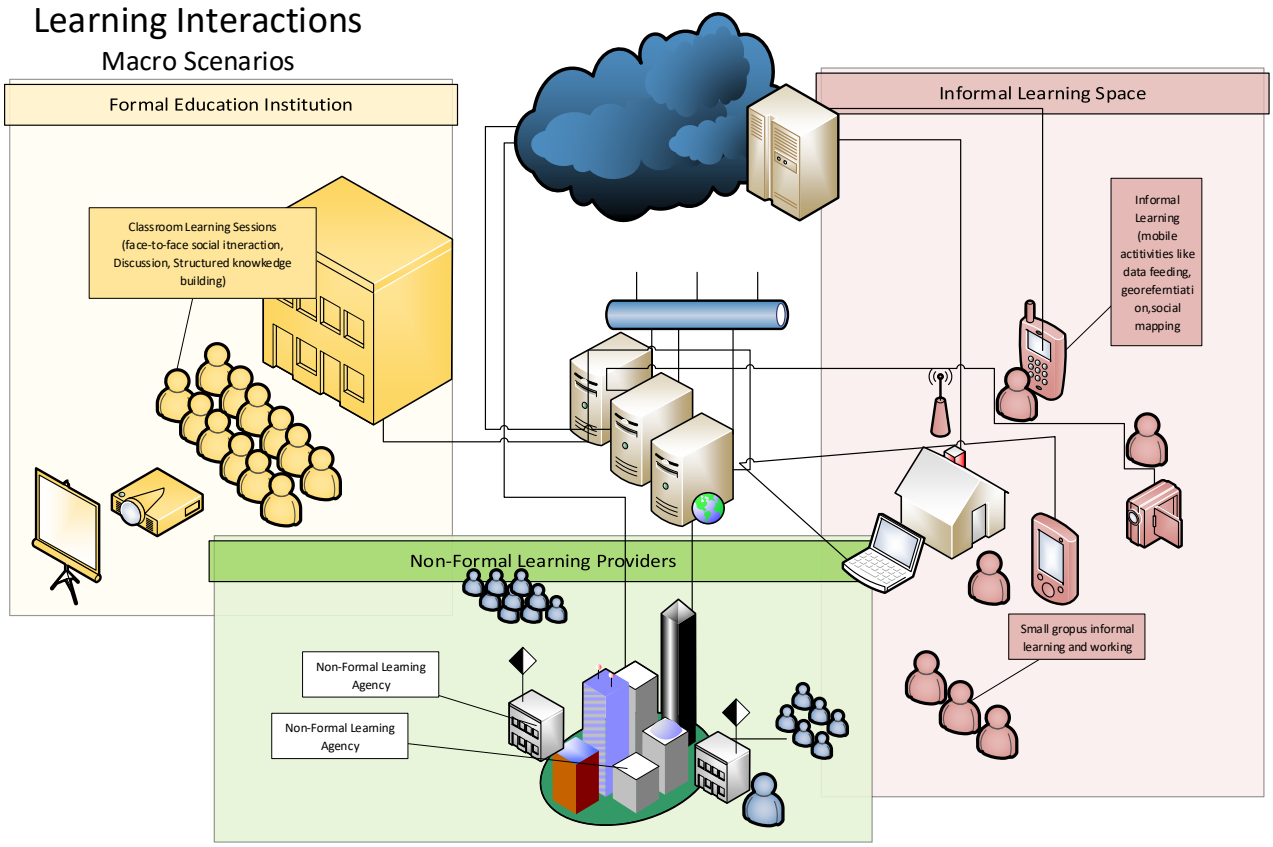

Figure 5.1: A graphical overview of interactions between formal, informal and non-formal learning domains

Further examples of external interactions with non-formal learning providers are analysed in Appendix B.

Type	Political support	Technological support	Tools involved
Type 1	MoU	Simplified recognition of an external Open Badge	Open Badge implementation
Type 2	MoU	Definitions of statements; verification of correct interpretation of the methods of tracking and assessment; possibly Open Badge definition	implementation of a set of xAPI tools in Up2U
Type 3	A collaboration process to identify shared definition of learning activities and assessment		xAPI common design and implementation of a set of tools in Up2U

Table 5.3: Types of interactions with external bodies

5.3 Example of Type 1 Interaction

In this example of a Type 1 interaction, an external agency defines, implements, manages and certificates a learning programme, and schools recognise the certification.

This scenario is the temporary result of contacts with AICA, represented by Michele Missikoff, held by Stefano Lariccia and Giovanni Toffoli, who are members of that professional association. A similar example can be excerpted and implemented from the Up2U original proposal, where we were talking of non-formal schools of computer science.

Title	ECDL – European Computer Driving Licence		
Pedagogy/ type of learning	Self-regulated learning PBL – Project-based learning		
Description/ context	This is an introductory course providing the learner with basic knowledge and skills to: • Select and manage a personal computer, hardware and software • Manage software updates; manage office automation tools; produce clear and fine digital documents ready to be shared, reviewed, published • Be able to identify trustable online sources		
Learning objectives	General transversal skills: Document and Information management, Media and Technology Literacy, Communication and Collaboration; knowledge building basic capacities		
Roles	Principal, teacher, learner, external teacher / external tutor		
Different types of learning content used	Online WBT; Online assessment with Open Badges Audio and video presentations (provided by external agency); other OERs		
Different types of learning services/ facilities/ tools used	External LMS and online assessment platform An external online platform providing an SRL (Self-Regulated Learning) learning path; an online final assessment platform with autonomous certification; A set of (possibly online) tools to perform the acknowledgement of the external certification(s) An optional set of tools to provide additional context-specific integration of learning units to integrate content in a specific job-oriented situation (information, competencies related upgrades and / or updates)		
Different types of collaborative activities	Shared promotion of certification; final live examination; asynchronous communication and document sharing; certificates inter-operative reporting		
Learning activity workflow	*(how actors/content/services interact)*		Tracing
Phase 1	Introduction, motivations, and competency profile acquisition to adopt a specific 3rd-party certification	Teacher and learners meet in person: teacher briefly presents objectives and structure of the course; teacher assigns tasks to each learner	Y

Title	ECDL – European Computer Driving Licence		
Phase 2	Competency and knowledge acquisition guided by a third-party tutor / teacher:	Learners join an external agency online course – Learner updates her/his internal teachers about a subscription Learners follow course materials presenting the subject in detail. Learners get through the course and get an in-progress assessment. External tutor helps learners to overcome problems and provide alternative materials. Each learner fills in a final assessment questionnaire.	Y
Phase 3	3rd-party assessment acquisition and distribution of a formal (digital or material) certification	Integration of an Open Badge-based ECDL certification into a catalogue of trusted certifications in an Up2U repository	Y
Phase 4	Formal recognition by the school teacher of the learning activity performed, and certification gained	Teacher training during the 2nd cycle of Pilot supporting teachers in easily converting an external (non-formal) Open Badge into the credits system of her school	Y
Phase 5	Discussing and sharing the experience with peers in schools	Teachers, students and principals should be incentivised by mentors to exchange information about external credits acquisition	Y
Phase 6	International assessment: revision of the learning path followed by each learner; international recognition of certification	Up2U community must host a discussion with partners on how to exchange best practices between different national educational communities.	N

Table 5.4: Example of Type 1 interaction: ECDL

6 Conclusions, Suggestions, Future Directions and Commitments

This deliverable concludes with a summary of future actions that form a clear and coherent roadmap, showing what each Work Package is expected to do to help Up2U scale up the number of participating schools to meet KPI targets.

The Up2U project will be increasingly successful as more and more teachers and students use its ecosystem in the classroom and in non-formal learning activities, to acquire and reinforce the core set of target competencies Up2U has identified as important for bridging the high school – university gap. The role of school teachers will be crucial both for increasing their use of skills-centred pedagogical approaches in their teaching and adopting the Up2U ecosystem, as well as for co-creating curricular content and sharing resources with communities of practice across Europe and beyond. The creation of effective communities of teachers and students using specific tools such as social networks, as well as local communities using open source platforms such as CommonSpaces [CommonSpaces], represent key indicators to assess Up2's activities, together with additional measures such as numbers of teachers who completed Module 1 of the Continuing Professional Development programme and continue to Modules 2 and 3.

The central challenge for this project is to have a significant impact on thousands of students' lives, reaching them where they spend most of their time: in school as well as on the Internet. Up2U has already started working towards these long-term targets, and dissemination actions are described in *Deliverable D2.2 Dissemination and Outreach Report Year 1*, with a summary of plans to scale up the pilots also described in *Deliverable D7.2 Report on the First Release and Demonstration of Scalable Pilot Services*.

In a reality as complex as a Europe-wide project, this approach can be slow at the beginning: each country has its own specificities, school systems differ, as do students' and teachers' background knowledge. However, as outlined in Section 4, national educational communities have been major players in Up2U from the start, even before the project was accepted and financed. Together with Up2U's national Subject Matter Committee representatives, as described in *Deliverable D5.1 Subject Matter Committee and Training Plans*, these national educational communities will continue to be part of the design and development process, to ensure that we provide schools with optimal needs-based solutions that also reflect constraints that currently characterise many schools in the pilot countries.

These constraints represent significant challenges, as shown by the results of Up2U's data collection in Year 1. As described in Section 2, our surveys and in-depth interviews with teachers in eight countries revealed a general picture, emerging from the picture of the pilot schools, of a school world anchored to educational models in which the development of skills crucial for bridging the high school – university gap is made difficult by the lack of adequate preparation and dissemination of innovative practices that effectively exploit digital technologies to enhance teachers' role. Teachers and

principals outline a reality where little attention is devoted to training and the subsequent implementation of, for instance, PBL models, and the use and reuse of OERs. Above all, a vision seems to be lacking that unites students and teachers as knowledge-sharing communities, working in direct contact with external agents such as universities and industry. In addition, the surveys showed that teachers seem to represent a wide range of points along the "technology take-up" continuum and dealing with this wide diversity represents a key challenge for designing needs-based CPD not just across countries but also possibly in peripheral and geographically isolated areas within the same country. In addition to diversities between countries, within some countries, particularly in peripheral areas, there is often a wide separation between researchers and teachers in the field and this additional challenge often prevents research findings on best practices for integrating non-formal and formal learning from filtering down into mainstream high school classrooms.

To ensure that Up2U can meet the challenges outlined above, during the first stage of the project we held advisory sessions with leading experts from the educational technology community to provide project partners with an overview of current cutting-edge learning technology as preparation for selecting optimal solutions that best meet the project's pedagogical needs. This activity of "scouting" the techno-pedagogical community will continue also in the second part of the project, and we plan to consult with providers of a social learning, community management platform, multi-lingual content management tools or services and one or more platforms for co-creation and editing of educational gaming tools.

Experts we have consulted with until now include:

- Svein-Tore Griff (17th October 2017)

  Founder of H5P – creating, sharing and reuse of HTML5 content and applications.

- Martin Dougiamas, Moodle Founder & CEO (12th December 2017)

  We established periodical videoconferences with Martin and some of his colleagues to advise us on techno-pedagogical aspects.

  Our first meetings with Martin and the Moodle HQ explored: (a) how the Up2U community can benefit from the "Teacher Training" courses, based on five pedagogical teaching methodologies, developed by Moodle HQ; (b) joint publishing of a white paper on best practices regarding Moodle architecture installation for a distributed environment, high availability and performance; (c) how to collaborate with Moodle and Moodle partners to create an Up2U distribution template which will be available for Up2U schools through Moodle cloud plan.

- Nadav Kavalerchik (24th April 2018)

  An open source expert, presented the use of the Learning Locker solution and learning analytics for teachers' use.

  As follow-up to this meeting, Up2U's pedagogical and technological partners had a videoconference with Ian Blackburn from HT2Labs and, we agreed to set up Learning Locker (LRS) and integrate it firstly with our Moodle instances, then with other platforms able to feed LA data. When initial courses in classrooms are in place, we will start defining some simple learning analytics reports that will be easily used by teachers and students in the pilots. At the same time, we will develop with teachers shared patterns and recipes to be adopted by teachers with the minimum labour overhead.

We foresee that some development will probably be needed to enable reporting relating to groups of students, which is apparently not fully supported right now. However, we need first to have in place an application for the group and authorisation management. We must also determine if and to what extent we need users' personal data in LRS. Probably anonymous xAPI statements could be stored in LRS to avoid privacy issues, although we want to collect learning records not only from LMS but also from other web tools that will be integrated into Up2U NGDLE. We have started with Moodle in the first phase of the pilot, but we need also to think about other tools talking to LRS. CommonSpaces, which is an EU project that supports international co-learning and e-mentoring Communities of Practice, is able to interact with an external LRS and we have already started to sync with this project.

6.1.1 Planned collaborations with additional bodies

SELFIE

As described in Section 2, Up2U has established contact with the SELFIE team, which aims to reach hundreds of schools in Europe to help them assess their profile of digital competencies. Digital competencies represent the fourth "destination" on the learners' path in Up2U's ecosystem, and the SELFIE team, at the time of signing our memorandum of understanding, sees the importance of possible cooperation with Up2U to activate schools by building their awareness of their digital needs and helping them utilise formal and informal learning activities to meet these needs.

IEA

Up2U has established initial contact with IEA, which is described in the international literature as "an independent, international cooperative of national research institutions and governmental research agencies. It conducts large-scale comparative studies of educational achievement and other aspects of education, with the aim of gaining in-depth understanding of the effects of policies and practices within and across systems of education." (Cited from IEA website [IEA])

Up2U and IEA are currently exploring possibilities for promoting, together with national committees of IEA in each Up2U member country, a new framework of research on educational efficiency in European countries, focused on assessment of non-formal and informal learning and of the acquisition of transversal competencies through the diffusion of a homogenous technology ecosystem. Up2U's national reports about learning assessment in each country will be communicated to the IEA in 2019, to evaluate the possibility of further joint research to be planned for the follow-up stage of Up2U.

Planned collaborations between Up2U, IEA and SELFIE could result in the empowering provision of a structured survey to produce "modular profiles" of self-perceived needs in terms of digital-competencies in the secondary schools across Europe. In addition, these collaborations would enable Up2U to function as a connection between these perceived needs and the objective data resulting from a statistical analysis supported by: a) the implementation of feedback collection integrated into Up2U by WP7; b) a well-established network of institutions (IEA, SELFIE) performing the assessment of education systems around the world. These assessments, since 2006, are more and more interested in the evaluation of the digital competencies and their impact on basic competencies like numeracy, literacy, comprehension and critical thinking.

This section began with an outline of the challenges facing Up2U and we have outlined above (1) our work with national Subject Matter Committee representatives, as described in Deliverable D5.1, and national educational communities, (2) consultations with expert advisors and (3) investigations into possible collaborations with SELFIE and IEA as three examples of Up2U's attempts to meet these challenges. To conclude on a positive note, Up2U also has a number of unique strengths that will help us meet the challenges described above: These strengths include (1) Up2U's unique mix of technology and pedagogy expertise that our university, industry and research institution partners such as CERN bring to this project, (2) strong and productive relationships between these partners, as well as (3) GÉANT network's interconnections with its 38 national research and education network (NREN) partners and 10,000 secondary schools across Europe. Table 6.1 below summarises commitments expected from all partners to continue successful development of Up2U's NGDLE.

6.2 Roadmap of Future Commitments

A significant effort is needed from all the partners to continue our common interactive design of our NGDLE. Table 6.1 presents a list of basic expectations from every partner, as anticipated today:

Future Action	Objectives	WPs involved	Owner
Sign MoUs with schools	Collect an average of 120 schools per Pilot country that are actively interested in testing with Up2U NGDLE through a leading role of a group of teachers	WP2 WP5 WP7 WP8	WP7
Sign MoUs with third parties	Reach another class of schools (something like 80 for each Pilot country) through the interest of teachers already involved in activities with external agencies (ECDL, SELFIE, EIC-Climate KIC, CERN)	WP2 WP5 WP7 WP8	WP8
Providing feedback to single learners or informal groups of learners when they enter the NGDLE from Internet	Trying to get in contact with the schools of these "nomadic learners" and have the school undersigning the MoU	WP2 WP5 WP7 WP8	WP8
Definition of sources of learning statements	Preparing a Repository for LA	WP4 WP5 WP7	WP5
Collection of xAPI Vocabularies related to secondary schools learning	Preparing a Repository for LA	WP4 WP 5 WP7	WP5
Defining Pilots' 2nd Cycle	Planning and implementing a 2nd cycle of Pilot with 3 Modules	WP5 WP7	WP7
Defining Pilots' 3rd Cycle	Planning a 3rd cycle of Pilot and implementing the 1 Module; letting schools	WP5 WP7	WP7

Future Action	Objectives	WPs involved	Owner
	and other agencies to carry on these follow-up		
Collection and classification of Learning Units – Learning Scenarios	Establishing a connection with Merlot and OER Consortium	WP5 WP7	WP5
Publish the Up2U platform to teachers' communities and organisations	Publishing a full version of NDGLE for learners teachers and schools	WP5 WP7	WP4-WP7

Table 6.1: Future actions planned

Appendix A Comprehensive surveys analysis and results

A.1 Pilot-Schools State of the Art of: Technology Enhanced Learning, student-centred learning and informal education

- As part of the multi-level survey that the WP5 administered, the second questionnaire aimed to gather information about teachers' practices both with and without technologies. Results revealed that computer equipment and Internet-based resources are mainly used by students to search for multi-media materials, work together on tasks and projects and search text-based materials required for learning assignments. Technology is hardly used at all to collaborate with experts and peers from outside the school. Students usually use technology as part of the whole class (one device per class, 1.96). Digital material used by students consists mainly of video files (88.49%), text materials (85.61%), online exercises (69.42%).
- According to the sample, technology could efficiently help high school teachers to prepare teaching materials (e.g. multi-media presentations, other materials, OERs), promote new ways of teaching, and learn new educational methods. On the other hand, technology would not be very useful for improving students' marks and managing their behaviour. The actual use of technology-enhanced learning would however be deeply impacted by generally not having well-equipped classrooms or technical support.
- Other items highlighted how teachers receiving training on the integration of technologies in their subject area are on average just 1.97 (4-point Likert scale), and those trained on project-based learning 1.61. The figure is even lower when it comes to using OERs (1.27).
- The third questionnaire was about actual pedagogical practices in the school and it served the purpose of providing us with useful information to define the suggested User Interaction model, by also adequately modelling Up2U environments and tools. Starting from the data collected, each partner drew up specific teachers' portraits responding to user profiles of different levels: basic, intermediate, advanced. The portraits were based on a participatory observation of practices and on the use of the interview as a means of dialogue to encourage an unlimited and in-depth description of practices. A total of 16 portraits were obtained: 3 from Greece, Italy, Israel and Poland, 4 from Hungary.
- Looking at the portraits, a picture emerges that makes it possible to position pedagogical models and the use of technologies along a continuum that goes from traditional models, for which technologies are few or non-existent, and in any case under-appreciated, to models in which the potential of technology is fully tapped, being of service to active, motivating and effective teaching. The figures below (Fig. 3 and Fig. 4) summarize these steps using information provided by the teachers themselves:

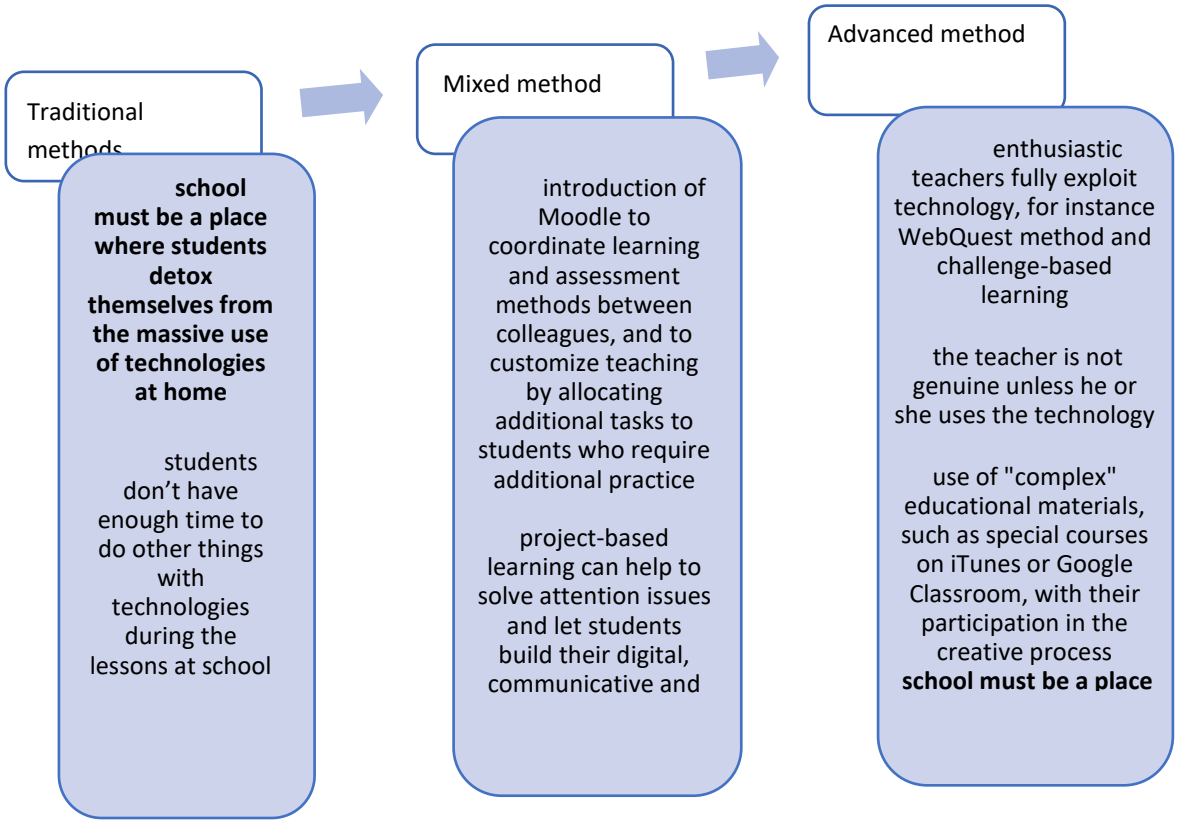

Figure A.1: Teaching models

- Analysis of this and the next chart confirms the view given to us by the analysis of the surveys. The school world is divided between transmission models anchored to a rigid and fragmented vision of learning, where all that counts is preparing for exams and memorizing as much information as possible, and the use of technologies is viewed as an intolerable waste of time and energy, and on the other hand flexible and dynamic models, in which digital tools and environments are implemented smoothly in daily teaching activities. Other elements emerging from the portraits include infrastructure support, organizational assistance, training, trialling and cross-collaborations both inside and outside single schools. Finally, an important role is played by the psychological components of each teacher, as we shall see in the final paragraph of this chapter.

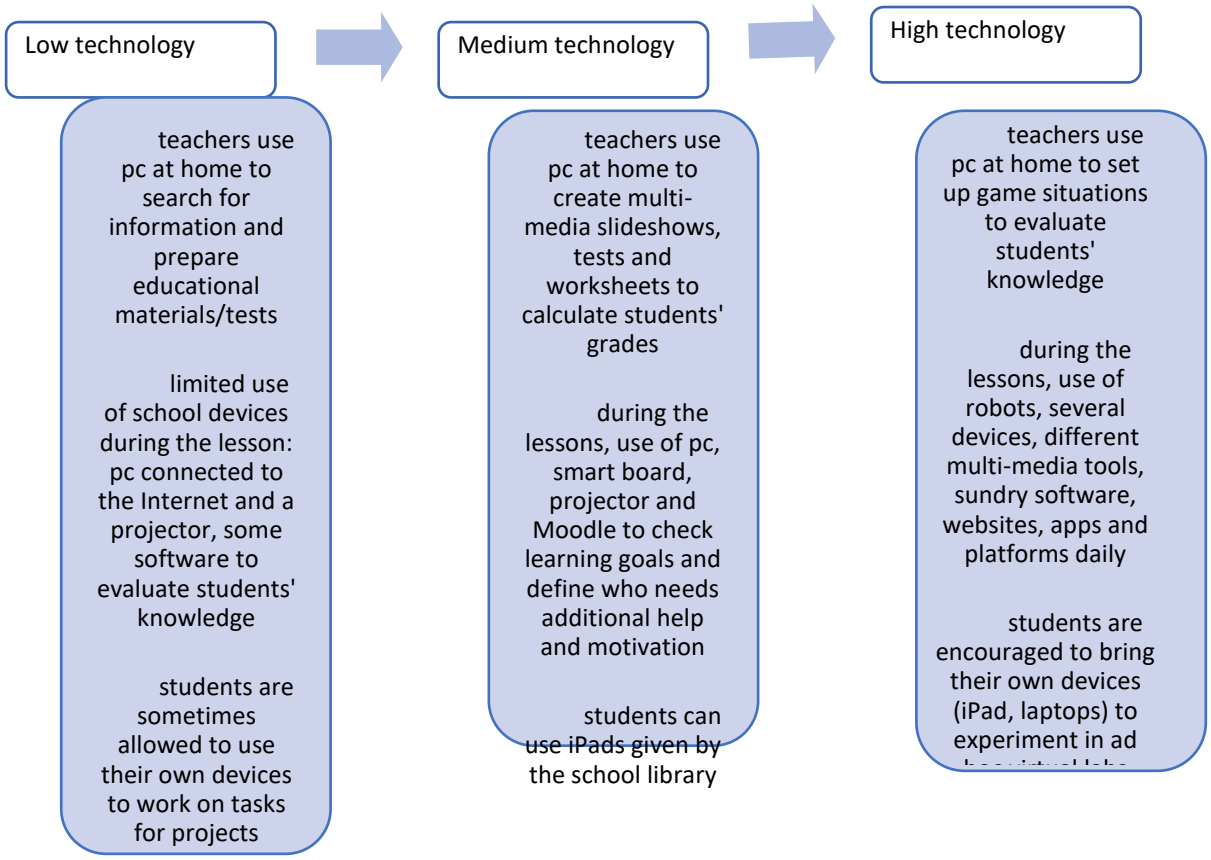

Figure A.2: The use of technologies for preparing and managing the lesson

From the DoA: analysing student behaviour individually and collectively to improve the learning experience and pedagogical efficacy of the learning materials used

- From a purely numerical point of view, experiences of a virtuous and fruitful use of technologies are quite few, but in qualitative terms, some experiences are exemplary. And it is just from these experience that we started our reflection about Learning Scenarios suitable for our NGDLE.
- The survey here presented was designed to actively involve the main recipients of the Up2U project: the school and university as environments responsible for the education of future citizens equipped with the skills needed to be successful and achieve challenging goals in the modern-day knowledge and network society. The information and views gathered through these surveys are therefore a valuable starting point for defining the training and development priorities of teachers and students.
- However, we are aware of some methodological limits, mainly related to the sample not being equally representative of the respondent countries, as well as numerically uneven between university and school. Yet the amount of data collected, and the heterogeneity of the curricular areas represented could be a strength of this tool. Another critical point of our survey was the lack of students' position (also due to the above cited delay of starting the 1. Phase of Piloting). Anyway, we decided to consider this stakeholder being more homogeneous than the teachers' one and already well described in the original proposal. Basically, we assumed that:

- nowadays students are very used to interact with Internet for communication and enter making but also in education, especially for informal learning (see the YouTube tutorial phenomenon)
- the clear majority of them has an easy access to a private connected device, as the original project pointed out. The quality of the connection is not always the best one, nevertheless learners use it naturally.

- Analysing Students behaviour individually and collectively to improve the learning experience and pedagogical efficacy of the learning materials used is an activity that must be postponed the second Module of 1st Cycle, under the coordination of WP-7

A.2 Conclusions taken from literature reviews and initial surveys of our stakeholders

In the previous paragraphs we explored the views and experiences of teachers regarding the central theme of the Up2U project: how to promote crucial skills using effective technologies in daily teaching, capable of really bridging the gap between the school world and the world of higher education and work. We have seen that teachers identify specific skills among key skills and recognize that one of the main limitations of the school is its being anchored to obsolete models that are no longer able to engage the student of today and to promote lasting and significant learning. The general picture that emerges is that of a school world anchored to educational models in which the development of skills crucial for bridging the gap is made difficult by the lack of adequate preparation and dissemination of innovative practices that effectively exploit digital technologies to enhance teachers' role in a systemic and cross-disciplinary perspective, where the rigid boundaries between physical and conceptual spaces fall, where schools become experimental laboratories of real practices in the real world. Teachers and principals outline a reality where little attention is devoted to training and subsequent implementation of - for instance - PBL models, and the use and reuse of OERs. Above all, a vision is lacking about students and teachers being a community of knowledge-building practices, working in direct contact with universities, businesses and institutions. In this context, technologies, though present to an extent, are not well exploited.

Recent studies claim that most teachers use technologies to support traditional ways of teaching and learning, without exploiting their true potential (Harris, Mishra & Koeheler, 2009; Polly, Mims, Shepherd & Inan, 2010; Sipilä, 2014). Why is this still happening? A potential reason is the training received by teachers. There is a general tendency to structure teacher training paths as courses in which the theoretical and methodological importance of technologies is not actively linked to learning (Barton & Haydn, 2006; Tondeur, Roblin, van Braak, Voogt & Prestridge, 2017). In such cases, they have no active role in the learning path, being unable to fully understand or indeed experience several important practice-based considerations:

- How, why and when to introduce technology, based on contingencies such as the subject taught, type and number of students, learning objectives;
- The potential of technology to add value, as well as its constraints;
- How to effectively integrate technology in the classroom, or how to use it at a distance;
- The ways in which technology can support students' engagement and their development of crucial social skills

In this Annex we have highlighted the basis on which the WP5 has grounded its goal to describe and analyses the project pedagogical principles and policies. Chapter 4 will focus on how these suggestions will become more and more practical by the introduction of actual Learning Scenarios, by describing Teachers and Students' path in the Up2U ecosystem, and finally leading to shaping a number of possible Interaction Design Models

Moreover, the effect of passive and theoretical exposure to a digital tool is that trainees cannot prove themselves as able practitioners, so they are left with a general sense of inadequacy when it comes to successfully incorporating technology in their teaching (Banas & York, 2016).

Other studies report how, in addition to training and obvious external factors such as the technological equipment available in schools (Kopcha, 2012; Martinovic & Zhang, 2012), teachers' individual differences also play an important role in their willingness and ability to include technology in the teaching process (Kounenou et al., 2015). Specifically, Ertmer and colleagues (2007) found out that both extrinsic and intrinsic factors are relevant mediators in teachers' perceived ability to use technology in a significant way in their profession, with a prominence of intrinsic factors, such as an individual's attitudes, belief system and confidence. Similar conclusions have been reached in another study by Sadaf, Newby, & Ertmer (2016) who investigated the connection between pre-service teachers' beliefs and attitudes, and their use of Web 2.0 / Web 3.0 tools in classrooms. Findings demonstrated that a positive attitude towards technology - meaning essentially a belief in its usefulness - led to a more consistent introduction of these tools.

Introducing technologies is not, of course, sufficient to positively influence educational practices alone. Rather, technology should be used as a tool to mediate the construction of a student's collaborative learning. It is up to teachers to guide students towards this digital wisdom (Prensky 2010)[9], by setting up meaningful learning contexts in which they are encouraged to use the artefacts of our digital culture to access shared knowledge, build knowledge and solve real problems, with the end goal of finalizing learning through the construction of a product (Biggs, 2003[10]; Marton & Trigwell, 2000)[11].

[9] Mark Prensky, «Using technology in partnering», 2010, http://www.d.umn.edu/~dglisczi/5917/ed ad tech seminar readings/Prensky (2010) Ch6.pdf

[10] John Biggs, Catherine Tang, John Kirby, «Teaching for Quality Learning at University», 2003, http://hust.edu.oak.arvixe.com/media/197963/-John_Biggs_and_Catherine_Tang-_Teaching_for_Quali-BookFiorg-.pdf

[11] Ference Marton, Keith Trigwell, Higher education research & development., Higher Education Research & Development, vol. xix, Carfax International Publishers, 2000, http://www.worldcat.org/title/variatio-est-mater-studiorum/oclc/682573213&referer=brief_results

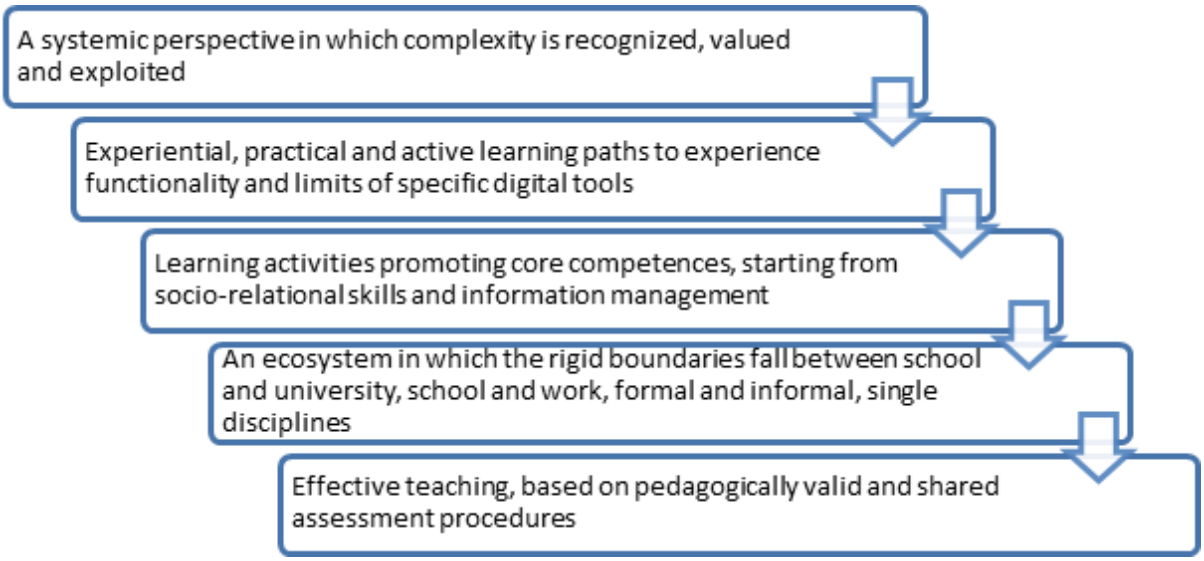

Figure A.3: Up2U core pedagogical principles to drive a NGDLE

Appendix B Further Learning Scenario Examples

B.1 Learning Scenario 1.8 Keats and Shelley: poems and life of two Romantics

Keats and Shelley: poems and life of two Romantics" by La Sapienza University of Rome

Title	Keats and Shelley: poems and life of two Romantics
Authors, providers	Ilaria Bortolotti and Nadia Sansone (UROMA)
Pedagogy/ type of learning:	Project Based Learning (PBL), Collaborative Learning, Flipped Classroom
Description/ context:	This course is a fictitious example representing a part of an English Culture and Language curriculum. The learner acquires theoretical knowledge through OERs and videos consultation, then discuss and apply his knowledge to critically analyse poetic texts and make connections through history, culture and literature, enhancing ICT and linguistic competencies while developing transversal skills. Context: high school
Learning objectives:	• **acquire and further develop knowledge** about the Romantic literary movement in Europe, focusing on the English production of two important poets such as Keats and Shelley • develop **language skills**, such as comprehension, analysis and production of different types of text in English language • **experience and develop transversal skills**, both cognitive and socio-relational: critical/reflexive competencies, such as reflection on and evaluation of personal and collaborative work, giving and receiving feedbacks, organizing collaborative work, taking responsibility, being autonomous, evaluating and managing information, taking notes, using ICT tools.
Roles	Teachers, learners, e-tutors
Different types of learning content used:	• OERs containing theoretical information about Romanticism in Europe, Keats and Shelley's lives and poetic production, some odes/poems critical analysis • Guided visit to Keats and Shelley's Houses in Rome • Short documentary

Different types of learning services/facilities/tools used	• a LMS platform in which to upload educational materials to be shared • repositories to research for reliable OERs about the topic and in which to upload and share multimedia presentation and OERs • tools to: create interactive lessons (audio, video + slides), collaboratively write texts, collaboratively create multimedia presentation (audio, video + slides or text) and OERs, communicate outside the classroom and to organize virtual meetings, communicate and discuss on the LMS platform, create a multimedia quiz/test to be uploaded on the LMS platform
Different types of collaborative activities:	• searching and then analysing a poem by each author (based on specific criteria: language, theme, peculiarity etc.) • reporting the analysis on a shared document • creating a multimedia presentation following some key points highlighted by the teacher and through the Role Taking strategies • peer review

Learning activity workflow (how actors/content/services interact):	The course is comprised of five phases:	
	Phase 1: Register to the LMS *Day 1*	The teacher presents the activity to the learners: topic, tasks, timing, methodologies, tools to be used and final goal to be achieved. Then, he/she introduces the e-tutors and their role in the activity (supporting students and monitoring the activities). Each learner registers to the LMS platform, helped by the teacher and the course facilitator. A short practical lesson is devoted to get to know the tools.
	Phase 2: Knowledge Acquisition *Day 2-4*	At home, learners watch teacher-produced and/or selected OERs about: ● Romantic movement in Europe and in England (literature, art, society etc) ● Keats and Shelley poems and odes The e-tutor monitors learners' work in terms of access and views, and support learners in the usage of the LMS.
	Phase 3: Knowledge application *Day 5-6*	At school, learners guided by the teachers discuss about the Romantic Movement (peculiarities, connections with other fields of the human knowledge, liked or disliked elements by learners), whereas a student take notes about the main points and posted it on the LMS to act as a diary of the classroom activity and as a starting point of further phases. After the discussion, group-work starts: learners divided in group and guided/monitored by the teacher search on the Internet and then analyse one poem by each author), collaboratively writing down their personal analysis (language, theme, peculiarity etc.). All the documents are then shared on the LMS and peer-reviewed, based on criteria provided by the teacher. **Targeted Skills** ● language skills ● cognitive and socio-relational skills: ○ critical/reflexive competencies ■ apply theoretical knowledge to make connections ■ reflection on and evaluation of personal and collaborative work ■ giving and receiving feedbacks ○ collaborative work skills ■ organize collaborative work ○ cognitive skills ■ take responsibility ■ being autonomous ■ meet deadlines

B.2 Learning Scenario LS 2.7 Introduction to crowdsourcing in the open maps domain

This learning scenario was inspired by real local mapping campaigns of OpenStreetMap (OSM). OSM is an international project that relies on voluntary and widespread activity to build a world map released under a free license. OSM covers territories where Google Maps can't or won't get there

Title	**Introduction to crowdsourcing in the *open maps* domain**		
Pedagogy/type of learning	PBL - Project based learning PBE - Place based learning Education		
Description/context			
	This is a theoretical and practical course allowing the learner to: acquire the basic technical and ethical concepts underlying volunteered geographic information (VGI) contribution in the context of the OSM; become a productive "mapper" thanks to the mastery of the required techniques and tools; acquire the collaborative attitudes and practices typical of the local mapping groups that make up the OSM international and national communities; get feedback from analytics results		
Learning objectives	general transversal skills: Communication and Collaboration, Critical Thinking and Problem Solving, Information, Media and Technology Literacy		
	specific/domain skills: basic geographical concepts and GIS notions; conceptual model of the OSM database; crowdsourcing; VGI ethics; mastery of GPS-based devices and related applications; group negotiation for sharing objectives; some notions of activity analytics		
Roles	*mapper*; who adds "features" to the database of OSM *teacher*; a senior mapper with theoretical knowledge and communication skills *learner*; a would-be mapper *tutor*; an expert mapper working as a peer with a learner		
Different types of learning content used	audio and video wiki pages digital maps		
Different types of learning services/facilities/tools used	personal mobile device equipped with GPS map viewer app "feature" editor app analytics functions exploiting the *OSM Change History*		
Different types of collaborative activities	Learning by watching recorded and online demos Discussing and sharing choices Learning by doing alternately with peers (seeing and doing) Group reflection on results, also discussing analytics data		
Learning activity workflow	*(how actors/content/services interact)*		Tracing
Phase 1:	*presentation of the campaign*	Teacher presents basic GIS and VGI concepts with talk and video. Teacher describes the conceptual model of the OSM database. Senior mappers tell some story about how they started mapping and about recent mapping	

Title	Introduction to crowdsourcing in the *open maps* domain		
		campaigns. Each new mapper performs basic read-only operations on map views with the help of a tutor.	
Phase 2:	*planning of the mapping activities*	Mappers choose a region as the target for the mapping campaign. A senior mapper explains rules of engagement and the well-tested organizational scheme. Small mappers' teams are set up; each includes at least a senior mapper and a learner. A senior mapper subdivides the target region in zones and assigns one or more to each team. Teacher recaps technical guidelines. In each team, a tutor demonstrates basic VGI operations to the new mappers.	Y
Phase 3:	*carrying out mapping activities*	Each team maps the assigned sub-zone. In turn, each member of the team adds a feature and enters its attributes; the other members discuss the choice of the attributes. Teacher monitors work through analytics tools working on automatically collected data. All mapper teams keep in contact among them and with the teacher for communicating and commenting activity progress.	Y
Phase 4:	*debriefing*	All teams gather. A member from each team, possibly a learner, makes a short report on the activity done, on rewards got and difficulties met. Teacher reports on analytics outputs and demonstrates how they were obtained. All mappers comment the campaign, tell what they learned and make suggestions for next campaigns	?

B.2.1 LS 2.7 UML - activity diagrams description

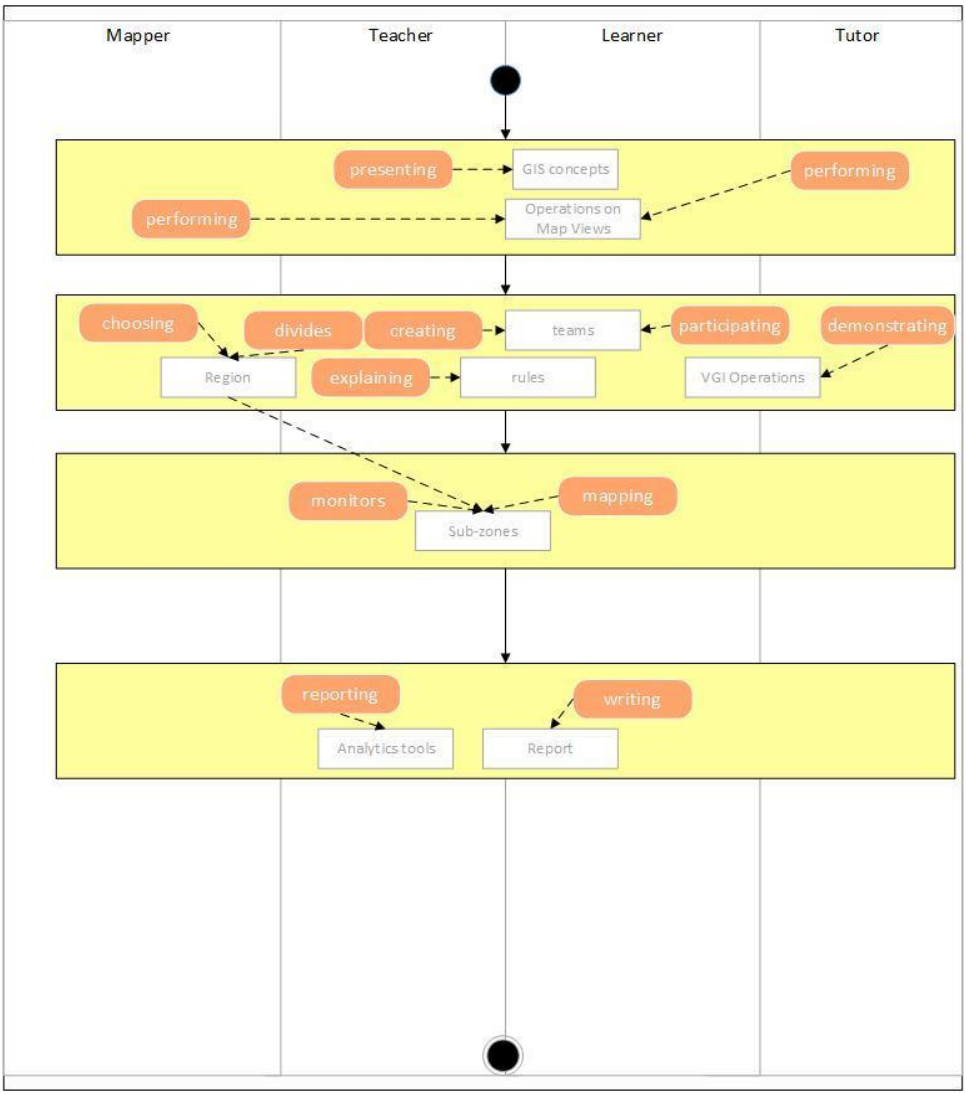

Figure B.1: Introduction to crowdsourcing in the open maps domain UML Activity Diagram

Appendix C Macro Learning Scenarios: Further examples of external interaction analysis

C.1 Macro Scenario type 2: Oriental Studies and Confucius Institute

Example based on a potential convention between Confucius Institute - Sapienza and a set of secondary school in Italy (Convitto Vittorio Emanuele Roma and others). This scenario is the result of contacts of Stefano Lariccia with Alessandra Brezzi, professor at Sapienza (Department of Oriental Studies).

Title	Confucius Institute Italy – Convitto Nazionale Vittorio Emanuele II Roma
Pedagogy/type of learning	SRL - Self-Regulated Learning PBL - Project based learning
Description/context	- This is an introductory course providing the learner with basic skills to: -
Learning objectives	- Language Education -
Roles	*teacher, learner, external teacher / external tutor; external community*
Different types of learning content used	audio and video presentations (provided by an external agency); texts of classical authors and other OERs; recorded audio-video dialogs; Online WBT; Online assessment
Different types of learning services/facilities/tools used	- An external online platform providing an SRL (Self-Regulated Learning) learning path; an online final assessment platform with autonomous certification; - a set of (possibly online) tools to perform the acknowledgement of the external certification(s); - an optional set of tools to provide additional context specific integration of Learning Units to integrate content in a specific job-oriented situation (information, competencies related upgrades and / or updates); - Optional certification of a derivative License (Confucius Badge Level1; etc;

Title	Confucius Institute Italy – Convitto Nazionale Vittorio Emanuele II Roma		
Different types of collaborative activities	Shared promotion of a Certification; Final live examination; asynchronous communication and document sharing Certificates interoperative reporting		
Learning activity workflow	*(how actors/content/services interact)*		Tracing
Phase 1:	*Introduction, motivations, and competence profile acquisition to adopt a specific 3rd party certification*	Teacher and learners meet in presence: teacher briefly presents objectives and structure of the course; teacher assigns different reading tasks to each learner. Learner reads assigned text and searches related materials on the web. Tutor helps learner online.	Y
Phase 2:	*Competence and Knowledge acquisition guided by a Third-Party Tutor / Teacher:*	Learners join an external agency online course Learner update her/his internal teachers of a subscription Learners follow course materials presenting the subject in detail. Learners get through the course and get an in-progress assessment. External tutor helps learners to overcome problems and provide alternative materials. Each Learner fills in a final assessment questionnaire. .	Y
Phase 3:	*3rd Party Assessment acquisition and distribution of a formal (digital or material) certification*		Y
Phase 4:	*Formal Recognition by the School teacher of the learning activity performed, and certification gained*		Y
Phase 6:	*International Assessment: revision of the Learning Path followed by each learner; international recognition of Certification; recommendation from the school to the agency*		Y

C.2 Macro Scenario type 3: Sustainability Education and Climate Change

Example based on a potential convention between EIT Climate-KIC, a community active on climate change in all major European countries, Sapienza and a set of secondary schools in Europe. This scenario is the result of contacts of Up2U researchers with EIT Climate-KIC and groups of teachers in Italy involved with Environment and Sustainability ONGs.

Title	KIC Climate Change		
Pedagogy/type of learning	SRL - Self-Regulated Learning; PBL - Project based learning		
Description/context	This is an introductory course providing the learner with basic skills to: - Understand what is going on with the climate changes that affect our planet -What everyone can do to share the awareness and mitigate the problem		
Learning objectives	- Sustainability Education		
Roles	*teacher (as a mentor), learner, external teacher / external tutor; external community*		
Different types of learning content used	audio and video presentations (provided by an external agency) texts of classical authors and other OERs recorded audio-video dialogs Online WBT ; Online assessment		
Different types of learning services/facilities/tools used	UpU2 NGDLE providing a SRL (Self-Regulated Learning); an online final assessment certification, provided by one or more Open Badges an optional set of tools to provide additional context specific integration of Learning Units to integrate content in a specific job-oriented situation (information, competencies related upgrades and / or updates) Optional certification of a derivative License (KIC Badge Level1; (KIC Badge Level2 etc		
Different types of collaborative activities	Shared promotion of a Certification; Final live examination; asynchronous communication and document sharing; Certificates interoperational reporting		
Learning activity workflow	*(how actors/content/services interact)*		Tracing
Phase 1:	*Introduction, motivations, and competence profile acquisition to adopt a specific 3rd party certification*	Personnel and activist of the ONG KIC Climate Change meet Up2U researchers to agree on a method of interaction in providing non-formal learning	Y

Title	KIC Climate Change		
		nto secondary schools in Europe	
Phase 2:	*Teacher Professional Development guided by the SMC or by Team of Mentors* *Competence and Knowledge acquisition guided by a Third-Party Tutor / Teacher:*	Teacher of the ONG will follow a series of Webinars hosted by Up2U consortium A first Module, 1st cycle will be held in selected Pilot Countries A pilot experience will end before the end of 2019	Y
Phase 3:	*3rd Party Assessment acquisition and distribution of a formal (digital or material) certification*	A third-party certification is developed with specific association (i.e.	Y
Phase 4:	*Formal Recognition by the School teacher of the learning activity performed, and certification gained*	Schools are guided, with an official endorsement from the education Ministry and from the Commission, to adopt and integrate the non-formal courses into their curriculum	Y
Phase 5:	*Discussing and Sharing the experience with peers in School.*	At the end of 2019 a workshop will discuss and evaluate the proposal and will publish data concerning the pedagogical experience. A final report will guide a follow up activity	Y
Phase 6:	*International Assessment; International recognition of Certification; recommendation from the school to the agency.*	Schools involved, and the ONG will draft recommendations on how to exploit the Up2U NGDLE potentiality	Y

Appendix D Some xAPI recipes and profiles potentially useful in the analysis of Learning Scenarios

In the xAPI terminology

- a recipe is a standard way of expressing a particular type of experience; it consists in a predefined collection, possibly a sequence, of statements (verb + activity type) typical of a certain field of activity
- a profile is a set of terms (verbs and activity types) and of rules on how to use them; profiles can be organized as sets of related recipes, possibly agreed between several institutions or communities of practice being active in the same sector.

Examples of recipes that we can propose are the following ones:

Audio/Video interview		
	The *Audio/Video interview* recipe (not a specialization of the Video recipe below) defines the statements issued for people willing to get transcriptions of audio or video interviews and to use and process them.	I recorded an audio/video interview I searched the web for an audio/video interview I transcribed an audio/video interview I edited an audio/video interview I summarized an audio/video interview I subtitled a video interview

Volunteered Geographic Information - VGI		
	In the *VGI* recipe, derived from a scenario analysis that was carried out within the OpenStreetMap community, some statements are obtained by combining systematically verbs typical of databases with entities and attributes typical of the specific domain. Verbs “create”,” delete” and “modify” apply to “features” (both geometrical objects and POIs = “points of interest”) and to relationships among them. Verbs “add”, “remove” and “update” apply to feature attributes (elevation, coordinates, service hours, aso)	I created/deleted/modified a feature I added/removed/updated a feature attribute I created a mapping team I created a mapping team I added a member to a mapping team I communicated my position I started a mapping activity I completed a mapping activity I reported on a mapping activity

Recipes and profiles can help in analysing scenarios and in designing analytics.

We report here below some publicly available recipes that could be of interest for Up2U; in fact, under the “xAPI Prototypes” heading, you will find not a single recipe but a collection of statements that are

emitted by a number of “prototypical” applications intended as promotional demos for the xAPI protocol.

We expect that other recipes will derive from our work with teachers and other stakeholders in the context of the Up2U Pilots.

Attendance		
	The attendance recipe defines the statements issued for people attending an event. This can be any kind of event such as meetings, classes, conferences etc. The recipe comes in two flavours: simple and detailed. The simple recipe simply tracks that a group of people attended an event. The detailed recipe additionally tracks the following experiences:	I scheduled an event I registered for an event I unregistered from an event I joined an event I left an event I opened (i.e. started) an event I adjourned an event I resumed an event I closed an event
Bookmarklet		
	The bookmarklet recipe defines statements that can be sent by tools that bookmark the learner’s activity on the internet. It covers the following experiences:	I experienced a web page I read a web page I bookmarked a web page I tweeted a web page
Checklist		
	The checklist recipe defines statements relating to checklists for performance observation, for example, a manager assessing an employee against a set of competencies. In this recipe, the person being observed is always the actor and the observer is the instructor. The recipe tracks these experiences:	Observer’s observation started Observer’s observation was resumed Observer’s observation was closed Observer’s observation ended incomplete Observer’s observation was completed/passed/failed Observer completed/passed/failed a checklist item An item in observer’s checklist was cleared (i.e. they need to be observed on that item again).
Open Badges		
	Open Badges are digital credentials awarded for achievement, engagement or improvement. The Open Badges recipe defines the statement to be sent when the learner earns an Open Badge.	I earned a badge
xAPI Prototypes		
	This is a collection of recipes describing the statements issued by the xAPI prototypes. These include a content launcher, a traditional e-learning course, a game of Tetris and a location based mobile game. These recipes and prototypes can be followed by real applications following a similar pattern. Together these recipes describe the following events:	I experienced a web page I launched a learning experience I initialized a session for an e-learning course I terminated a session for an e-learning course I attempted an e-learning course I resumed an attempt at an e-learning course I resumed an attempt at an e-learning course I suspended an attempt at an e-learning course I passed an e-learning course

		I failed an e-learning course I experienced a page of an e-learning course I answered an e-learning course question I initialized a session for a game I terminated a session for a game I completed a game I completed a game level I was at a location I attempted a task I completed a task
Video		
	The video recipe describes statements used to convey a learner's interactions with videos. It covers the following experiences:	I played a video I paused a video I watched a video I skipped a video I completed a video

Appendix E Some proposals for collecting analytics data from interactions in informal contexts

This annex contains some hints on how we could support the tracking of informal interactions of the learners with online media external to the NGDLE. Our objective is to make a few suggestions on possible technical developments and on a way of introducing some limited samples of Learning Analytics in the learning paths of the pilots for the teachers.

In a structured framework, the VLS can provide course materials already equipped with all machinery needed to track the learners while using those materials and undergoing evaluation tests. On the contrary, in our scenario the interactions being addressed are not under the control of a VLS; here the challenge, for the teachers and the learner themselves, is to reconstruct some aspects of informal learning processes, by applying Learning Analytics filters to scattered clues collected in a non-systematic way.

We wondered how to send xAPI statements to an LRS in the face of 3 types of interaction with external media:

- visiting a web page and possibly assigning a rating to it
- viewing a video, with the capture of events such as "play", "pause", "change volume"
- capturing bibliographic references in a semi-automatic way from within a web page.

The solutions that we outline may seem contradictory to our goal, given that, somehow, they still rely on a VLS; but the use of a VLS is mainly aimed at overcoming the problems of security (not disclosing the credentials of the LRS) and of identification of the user (the “Actor” element of the xAPI statement).

E.1 Visiting a web page

The first level of intervention is to give users (teachers and learners) simple instructions to create an "Up2U Bookmarklet", similar to the "xAPI Bookmarklet", in the bookmark bar of your favourite browser (such as FireFox or Chrome). A Bookmarklets “is a mini application consisting in a tiny snippets of JavaScript code that resides in your browser and provide additional functionalities to a web page” [Create Bookmarklets - The Right Way, https://code.tutsplus.com/tutorials/create-bookmarklets-the-right-way--net-18154].
The xAPI Bookmarklet allows the user to almost seamlessly create a series of bookmarks while navigating the web in a browser window or tab, but we cannot distribute its code since its contains LRS credentials that we could want to keep secret; the fact is that it communicates directly with the LRS, without any mediation. The Up2U Bookmarklet keeps the basic idea but sends page URL and Title to the VLS; provided that the user has already logged in from the same or another browser window,

the VLS adds the information identifying the “actor” and the “verb” of the xAPI statement and sends the basic statement (actor-verb-object) to the trusted LRS. Optionally, the VLS could also: a) make available online a Javascript library that supports the creation of a dialog to ask for additional data when the user clicks on the bookmark; b) support some post-processing to create in the VLS database a derived content, in the case of CommonSpaces an "OER", i.e. the metadata that describe the page or the remote website as a resource.

E.2 Watching and studying a video

We propose to add to the NGDLE the support for tracking the interaction with a video content at the level of individual actions such as "play", "pause", "change volume."
In HTML5 it is possible to implement with Javascript, within a web page, the interaction with local contents in different video (MP4, WebM, Ogg) and audio (MP3, WAV, OGG) formats; the author of the web page can program in Javascript also the sending of an xAPI statement to an LRS. A similar thing, coding at a higher level, could be done using H5P, a technology which is already available in Moodle-Up2U.
It seems that, using the "iframe API" of Youtube, you can capture and then trace individual events even when enjoying Youtube; perhaps even Vimeo allows you to control and capture individual events while viewing a video.
In CommonSpaces, an "OER" content can be used to catalogue a Youtube video, which through the OER is incorporated into a "Learning Path"; since the video itself is displayed through a specialized function, the capture of events related to the visualization of the video, and the creation and sending of xAPI statements to the LRS, could be automatic, without the creator of the content having to deal with it.

E.3 Bibliographic meta data extraction and standardization

Many Citation Manager tools, some open source, some proprietary, are available; examples are Citeulike, Endnote, Mendeley, and Zotero. They aim to automate metadata extraction, storage and reuse for a variety of different types of content: scientific papers, journals, books, proceedings, reports, movies, patents, video interviews and simple websites. Mendeley and Zotero, together, have approximately 3,1 million of users around the world (2,5 Mendeley and 0,6 Zotero), while 4.5 million researchers are on ResearchGate and 11 million users on Academia.edu, the two main aggregators of researchers in the publishing arena 12. Accepting and integrating interactions with these bibliographic information circuits can increase the appeal of our NGDLE and attract secondary education students and teachers. The activity of referencing a content is highly automated and can be usefully tracked. Bibliographic metadata have already chosen their interoperability standards; their champions tend to become something like "social networks of researchers". Up2U should invest in these networks and promote their use in secondary education, where a culture of traceability of contents has yet to spread. Being able to cite and to trace knowledge, in the sense of scientific knowledge, where new acquisitions

[12] Chen, Pei-Ying, Erica Hayes, Vincent Larivière, Cassidy R Sugimoto, «Social reference managers and their users: A survey of demographics and ideologies. », PloS one, vol. 13, fasc. 7, 2018, p. e0198033. http://www.ncbi.nlm.nih.gov/pubmed/29995889.

and new argumentations are subject to a formal judgement (peer review) is a habit that social communication should inherit from the scientific community; this skill cannot be missing in the toolbox of a teacher.

A simple option to start with, in our NGDLE, would be to create a Bookmarklet that, as in case 1., sends the URL of a web page to the VLS. This should ask the remote server for the entire HTML content of the page. Through pattern matching, a function of the VLS should analyse it, extract one or more bibliographic references and reformat them according to some standard. The user should filter, correct and possibly integrate the result of the automatic processing. Finally, the VLS should send to the LRS an xAPI statement to record the activity carried out by the user, saving the bibliographic reference(s) as its "Result". A variant could consist in the fact that the VLS first displays, in a simplified way, the sections of the original page that could contain bibliographic references; then the user selects, within them, through visual interaction, the content of real interest.

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Items in square brackets are cited in the body of the document; other items are cited in the appendices, or were used in WP5's research.

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[D5.3] *Deliverable D5.3 Skills Report and Training Updates*

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Glossary

Acronyms

ADL	Advanced Digital Learning Initiative
API	Application Programming Interface
ATS2020	Assessment of Transversal Skills 2020 ATS2020
CEDEFOP	European Centre for the Development of Vocational Training
CERI	Centre for Educational Research and Innovation
CL	Collaborative Learning
CPD	Continuing Professional Development
DoA	Description of Actions
DP	Design Principle
ECDL	European Computer Driving Licence
EFSS	Enterprise File Sync and Share
EL	Experiential Learning
FC	Flipped Classroom
GUI	Graphical User Interface
HE	Higher Education
ICDL	International Computer Driving Licence
ICT	Information and Communications Technology
IEA	International Association for the Evaluation of Educational Achievement
IPTS	Institute for Prospective Technological Studies
ISCED	International Standard Classification of Education
ISTE	International Society for Technology in Education
JRC	Joint Research Council
KB	Knowledge Building
KPI	Key Performance Indicator
LA	Learning Analytics
LA	Learning Approach
LD	Learning Design
LMS	Learning Management System
LRS	Learning Record Store
LS	Learning Scenario
MIL	Media and Information Literacy
MOOC	Massive Open Online Course
MoU	Memorandum of Understanding
NGDLE	Next-Generation Digital Learning Environment
OEC	Open Education Consortium
OECD	Organisation for Economic Co-operation and Development
OEP	Open Educational Practices
OER	Open Educational Resource

OU	Open University
PBE	Place-Based Education
PBL	Project-Based Learning
PD	Professional Development
R&E	Research and Education
SBL	Scenario-Based Learning
SCORM	Sharable Content Object Reference Model
SMC	Subject Matter Committee
SRL	Self-Regulated Learning
SSO	Single Sign-On
TLA	Trialogical Learning Approach
UGC	User-Generated Content
UI	User Interface
UML	Unified Modelling Language
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UX	User Experience
VLS	Virtual Learning System
WEF	World Economic Forum
WP	Work Package
WP5	WP5, Learning community management and skills training
WP5.2	WP5 Task 2, Teacher skills development
WP7	WP7, Pilot coordination and continuous risk assessment
xAPI	eXperience API

Terms

Term	Definition	context/references
Action	What remains of an xAPI statement after removing the "actor" element from the actor-verb-object triple: a "verb" (action type) being applied to an "object" (content or activity or "experience provider") that is an instance of some activity type.	ADL-xAPI
Activity	This umbrella term can be used as a synonymous of "action"; more properly, in the context of xAPI, it designates the "object" element of the action itself, or the object's type (activity type).	ADL-xAPI, UML, IMS-LD
Activity diagram	A diagram type in the UML toolbox, which provides a dynamic model of an interactive process; it is made up of “activities” to be executed in sequence and/or in parallel, under the “responsibility” of specific “roles”. Its use has been proposed also in the context of the IMS-LD.	UML, IMS-LD
Bookmarklet	Bookmarklets can be defined as mini applications masquerading as tiny snippets of JavaScript that reside in the browser and provide additional functionalities to a web page. A Bookmarklets takes the form of a bookmark in the Bookmark Bar of a web browser.	Web browser
Actor	The "principal" (individual or group) being the author of an action.	ADL-xAPI
Continuous Professional Development	The programmed sequence of learning and training activity dedicated on promoting and growing the professional competences of a teacher; can be implemented in a single Module or in multiple Modules. Can be iterated in multiple Cycles, recurring over programmed time slots	Pedagogy
Design Principle	An axiom extracted from one of the many pedagogical theory. It can be defined also as an operational concept that links pragmatic choices of Learning Design to philosophical and pedagogical theory as can be found	

Term	Definition	context/references
	published in the specialized literature We defined 7 Up2U Design Principles (axioms).	
IEEE	IEEE is "the world's largest technical professional organization for the advancement of technology". The name was born as the acronym of "Institute of Electrical and Electronics Engineers".	
IMS	Formerly acronym of "Instructional Management Systems", this is the abridged name of the IMS Global Learning Consortium.	
Learning Analytics	The measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs (definition from 1st International Conference on Learning Analytics and Knowledge 2011)	
Learning Design	The sum of multiform professional activity that produces as an output a Learning Path composed by Learning Unit, external activity, assessment activity. This term is often implicitly used to refer to IMS-LD, a standard proposed by IMS in collaboration with the OU of Netherlands.	IMS
Learning Journey	One singular instance of a Learning Path; an experienced learning path in the life of a learner	
Learning Object	Synonymous of "reusable learning unit". Formalized by several standards, including ADL-SCORM and IEEE-LOM. Learning units of different granularity can be modelled as Learning Objects.	ADL-SCORM, IEEE-LOM
Learning Path	A model for Learning Journeys. This term, abridged as "LP", has a specific meaning in CommonSpaces, where it represents an artefact which supports learning by assembling, according to a linear or tree structure, OERs (open educational resources) and some "connective" material.	
Learning Unit	This term does not require explanations. However, it is often used to designate not a unit in the learning process, but the content or courseware supporting it.	
Learning Record Store	An http server dedicated to collect and store Learning experiences records performed by learners in their formalized activity track	ADL-xAPI
Mentee	The subject with less experience in a mentoring relationship.	
Mentor	The role of mentor can be defined as in this proposition:" mentoring is a goal-oriented activity. In the professional mentoring conversation, the mentor has much of the responsibility for the quality of the conversation. Mentoring is based on an agreement between mentor and mentee and is therefore characterized by both structure and progression. Still, the main focus is on the mentee, regardless of whom the mentee is. Mentoring can therefore be considered to be a way to support the mentee's own learning process (Løw 2009)"	
Mentoring	The one-to-one supportive relationship between a mentor - a subject with more experience - and a mentee - a subject with less experience -, in an educational or work context. Also, programmes for organizing and promoting relationships of this type. Usually this term is used with a wider scope than "tutoring" or "coaching", not limited to a specific course or subject matter but including also social and psychological concerns.	
Object	In the educational field, often is used as an abridged form of "Learning Object".	OOP, education
Object	An element of the triple constituting the core of an xAPI statement.	ADL-xAPI

Term	Definition	context/references
Open Educational Resource	A Learning Object (not in the technical sense specified by ADL-SCORM or IEEE-LOM) being declared/considered "open" according to some conventions. Most OERs are accessible online, on the Internet.	
Pattern	“Pattern” is a generic term for a common shape or configuration of elements that can be recognized by humans and/or machines. In this document, it is used with different qualifications; for example: pedagogical pattern (= pedagogical approach), design pattern (relevant for design/software reuse), usage pattern (relevant for UX); we focused mainly “activity pattern” (relevant for analysis of learning scenarios and for learning analytics).	
Pilot	Broad activities of the Up2U project. These activities include CPD, ongoing discussions with stakeholders and attempts to scale up to target number of schools, wide-scale dissemination of project and recommendations to national level policy-makers. Each pilot consists of different atomic parts [STAGES, ASPECTS or PHASES]. For the purposes of Up2U, a pilot is an evaluation of the outcomes of the project in terms of pedagogy and technology, based on different activities that closely engage and collect feedback from the primary stakeholders of the ecosystem, i.e. students of high schools (see D 7.2)	Up2U
Pilot Cycle	Is a full sequence of Learning Modules (based on one or more Learning Unit and/or a sequence of Activities) that can be periodically iterated to different groups	
Pilot Module	Pilot Module is a subset of a Pilot Cycle; Modules are organized and aggregated to build Pilot Phase; multiple Phases aggregated build a Pilot Full Cycle. A module can be divided into phases, using	
Pilot Phase	Is a subset of a Pilot Cycle; can be assumed as based on a Learning Module or as based on multiple Learning Modules	
Profile	A set of terms (verbs and activity types) and of rules on how use them in building statements	ADL-xAPI
Recipe	In the xAPI terminology, a Recipe is a standard way of expressing a particular type of experience; it consists in a predefined collection, possibly a sequence, of statements related to a certain type of activity. Recipes can help in analysing scenarios and in planning analytics.	ADL-xAPI
Role	A basic concept in Learning Design, where activities are modelled mainly based on interactions between actors	IMS-LD
Sharable Content Object Reference Model	A standard for specification of Learning Objects, addressing also their orchestration, mainly in the context of a VLS.	ADL
Statement	In its minimum configuration, a statement is a "triple" consisting of an "actor", a "verb" and an "object" (see related entries). It represents the traceable content of an "experience", possibly an experience made in a formal learning context, that can be stored (in a LRS), interchanged and be the object of some analysis. A statement can include other attributes; possibly, the most interesting ones are "context" and “results”.	ADL-xAPI
Teacher Training	A specific Module in Pilots; it will propose to the teachers the same learning path that they will offer to their students.	
Tutor	An actor activating, enabling and monitoring student participation in learning activities.	

Term	Definition	context/references
Unified Modelling Language	A standard language used mainly in software engineering to model systems and software with an object-oriented approach. Includes several “views” or “models” with associated diagramming styles, supporting both analysis and design at different abstraction levels, and addressing both static and dynamic aspects. The most popular diagram types for modelling learning scenarios could be the Use Case Diagram and the Activity Diagram.	
Verb	A word or other symbol from a restricted vocabulary, usually being annotated with a suggestive name and a textual informal description, considered as an element of the triple building up a an xAPI statement. Most often, the verb semantics id "overloaded"; that is, only in combination with an activity type a verb takes a fairly precise meaning.	ADL-xAPI
Virtual Learning System	Can be seen as a generalization of LMS.	
eXperience API	A standard proposed by ADL to model, store and interchange "statements" describing traceable people actions and interactions between them and with passive and active objects. The former name of xAPI was "Tin Can API".	
xAPI Bookmarklet	The xAPI Bookmarklet can be considered a “squared” bookmark: not only it takes the form of a bookmark in the Bookmark Bar of a web browser; it also allows the user to almost seamlessly create a series of bookmarks, in the form of xAPI statements, while navigating the web in a browser window or tab.	ADL-xAPI
xAPI vocabulary	A reasoned collection of terms and definitions in the context of the xAPI standard: Verbs and Activity types, possibly aggregated in Recipes and Profiles.	http://xapi.vocab.pub/browse/index.html