BREAKING EDUCATIONAL BARRIERS WITH CONTEXTUALISED PERVASIVE AND GAMEFUL LEARNING

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Deliverable author(s)	Claire Dutertre, François Mohier, Olivier Heidmann, Raphael Attias
Partner(s)	ORT, COVUNI, UCM, SIVECO, SEBIT
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Project Coordinator

Coventry University

Sylvester Arnab

Priory Street, Coventry CV1 5FB, UK

E-mail: s.arnab@coventry.ac.uk

Project website: http://www.beaconing.eu

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Contributors

Contributors				
Version of document contributed to	Chapter	Contribution description	Institution	Name of contributor
V1	3.2.2	School System	SIVECO	Marius Preda
V1	4.1.2	Individual learning gain	UCM	BALTASAR FERNANDEZ MANJON
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List of abbreviations

AeL	Advance eLearning
API	Applications Programming Interface
BESA	British Educational Suppliers Associates
BIBA	Bremer Institut für Produkion und logistik GMBH
CPD	Continuing Professional Development
CPU	Central Processing Unit
DE	Department of Education
DEL	Department of Employement and Learning
DoA	Description of Action
EBA	Eğitim Bilişim Ağı/ Education Informatics Web
ECDL	European Computer Driving Licence
Gb	Giga Byte
GSCE	General Certificate of Secondary Education
HDD	Hard Disk Drive
HE	Higher Education
HWU	Heriot Watt University
ICT	Information and communication technologies
IMS	Information Management System
INRP	Institut National de Recherche Pédagogique
ISCED	International Standard Classification of Education
ISE	Inspiring Science Education
ISSM	Information Systems Success Model
MathML	Mathematical Markup Language
MoNE	Ministry of National Education Turkey
POSDRU	Programul Operational Sectorial Dezvoltarea Resurselor Umane
RAM	Random access Memory
SCORM	Sharable Content Object Reference Model
STEM	Science, Technology, Engineering and Mathematics
TAM	Technology Acceptance Model
UCM	Universidad Complutense de Madrid
VET	Vocational Education Training
WP	Work Package
xAPI	Experience API
XML	eXtensible Markup Language

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EXECUTIVE SUMMARY

The main objective of D5.3 is to design small-scale pilots of the BEACONING project, designated to provide schools, ICT suppliers and other stakeholders with:

- An analysis of the action research approach on STEM and ICT in education. In order to analyse the specific requirements, an investigation on teachers and learners' needs has been set up through questionnaires before the launch of the small-scale pilot.

- An insight into how the consortium partners manage the school pilot process with an evaluation process part of the BEACONING Platform. It details the pilot design around the specific environments and the school learning systems within the partners where the small scale pilots are implemented (UK, Italy, France, Turkey and Romania)

- An introduction to different evaluation methodologies and approaches used in schools pilots. The aim of BEACONING is also to make learning inclusive for individuals with disabilities; the pilot will therefore focus on the design of pilots that specifically target dyslexia and motor disabilities. This small-scale pilot design will involve and link to disability assessment in WP3 in order to address the needs – this will include interfaces and other assistive technology. The measures will include 4 levels: a level of acceptance, a level of motivation, usefulness and accessibility and finally the learning outcomes, etc.

The small-scale pilot design follows a bottom-up approach preliminary guidelines and recommendations for the large-scale pilot.

This will also include some of the learners identified at the test beds for the large-scale pilot in WP6. We are targeting an estimated 60 learners at ORT training centres (France) and around 10-20 learners from each of the other test beds as recruited and engaged in WP3.

The main objectives are to:
• Test the single components;
• Test the integrated platform;
• Execute the small scale pilots;
• Introduce recommendations for large scale testing based on small scale pilot results.

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1 INTRODUCTION

1.1 BACKGROUND

This report details the outcomes of the small-scale pilot design studies. The small-scale pilot design studies follow a bottom-up approach, which focus initially on analyzing key pilot implementation requirements.

1.2 ROLE OF THIS DELIVERABLE IN THE PROJECT

This deliverable presents preliminary guidelines and recommendations for the large-scale pilot that aligns with the pilot design in WP6. It has been prepared following specific guidelines described in the DoA and has been structured around the different test cases defined for the project.

1.3 APPROACH

The main outcomes of the activities carried out in Task 5.3 is to provide a measurement framework for small-scale pilots and verify that these small pilots help construct guidelines and recommendations for the large scale pilots. The piloting framework is to ensure issues encountered can be addressed early on and fed forwards to the deployment pathway of BEACONING educational technology uptake.

The aim of the pilot guidelines, therefore, is to increase the ability of the teachers and facilitators to better understand what is required in order to develop and run pilots in schools and particularly what outcomes they can expect from the BEACONING platform.

The investigation purpose of the small-scale pilot is the observation of teaching and learning activities using the BEACONING platform by the teachers.

Sample size: 30 participants in Ort France, 30 users in Romania (SIVECO), 10-20 learners from associate partners test beds, including UK , Italy and Turkey

Pilot duration: Several sessions of utilisation of the tools and the components (individual and integrated). Those sessions will validate the components on an individual point of view (rf. D5.1) and through an integrated manner (rf. D5.2).

Research method: Focus group, interviews

1.4 STRUCTURE OF THE DOCUMENT

The deliverable includes the following sections:

- Section 2 defines an analysis of the key pilot implementation requirements;
- Section 3 details the pilot design around the specific environments and the school learning systems;
- Section 4 provides a pilot measurement framework through indicators and specific measures.

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2 ANALYSIS OF KEY PILOT IMPLEMENTATION REQUIREMENTS

The analysis of key pilot implementation requirements addresses the path of deployment and uptake of an educational technology. For instance, in the ORT pilot, learners taking part in an already existing programme in technology are enrolled bringing BEACONING to their specific environments and needs.

In order to analyse the specific requirements, an investigation on teachers and learners' needs has been set up through questionnaires before the launch of the small-scale pilot.

2.1 CONTENT

Each learner is unique, and brings to the learning situation their own different knowledge set, experiences, and motivation. In learner-centered instruction, it is important for teachers to consider the level of knowledge and skill development attained by the learners prior to instruction. The best way to get this information is by asking the learners themselves. To determine the readiness of participants for learning, the teacher should decide, prior to the testing of the BEACONING platform, how to collect and use data on learner needs. The process of collecting and playing back this data can raise the level of participant excitement about the learning experience. We can use this knowledge throughout the rest of the educational process to customize instructional strategies in the platform and to enable learners to reach shared educational objectives.

Three questionnaires will therefore be addressed to the pilot users upstream from their testing on the BEACONING platform.

2.2 TEACHERS AND LEARNERS' NEEDS

In order to analyse the needs of our learners in our small scale pilot, we have identified the learning experience and the current state of knowledge and enthusiasm in STEM of the pilot learners. We identify potential learning needs in four different domains: cognitive, social, affective, and psychomotor. When facilitators establish a new learning environment, it is important that they assess preparation of participants in all four domains. (Annex 1)

BEACONING aims to make learning inclusive for individuals with disabilities. This task has then focused on the design of pilot that specifically targets dyslexia and motor disabilities, with the use of inclusive learning. BEACONING provides an educational environment in which students with disability can access, participate and ultimately succeed. This will include interfaces and other assistive technology. In order to make sure to fulfil their needs, we defined what this public expects from a digital platform on STEM through a questionnaire specifically dedicated to individual with disabilities. (Annex 2)

Do teachers have the skills and support that they need to teach through digital learning effectively? An analysis on the teachers' knowledge on digital learning and their need in this domain is made through a questionnaire specifically dedicated to digital learning and educators. (Annex 3)

2.3 LESSON PLANS

The lessons plans are based on templates, which include a range of elements, such as:

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- The educational objectives / standards to be attained;
- The flow and time frame of the learning and assessment activities to be delivered;
- The educational resources and/or tools that support the learning and assessment activities.

During the small scale pilot, the teachers will test each of the following spaces in the platform:

- Teachers 'dashboard;
  - accessibility to the office space, the classroom, the library, the profile screen;
  - accessibility to scenarios, community, profile information;
- Classroom space;
- Result page;
- Scenario space;
- Exercise space.

These are the samples to be used in small scale pilots to expose teachers to the methods in order for them to create and provide their own lesson paths or an adaptation of existing lesson paths for use in the small scale and or large scale pilots.

2.4 SCENARIOS

Each scenario has been adapted to the particular needs of each pilot. All the scenarios will be modified and updated accordingly after discussing them with the teachers.
The scenarios presented below tackle different learning objectives and have been select to show the variety of the play-lesson scenarios the BEACONING platform can support. This has been specified in the deliverable 4.8.

Introduction of scenarios for the following example topics:

- Basic mathematics notions;
- Programming and robotic;
- Optical;
- Digital identity;
- Entrepreneurship and programming.

The scenarios have to be developed in missions and quests:

Mission 1

- ⇨ Quest 1
- ⇨ Quest 2

Mission 2

- ⇨ Quest 1
- ⇨ Quest 2

Appropriation of the tool, creation of scenario and diverse ideas:
Teachers need support to develop suitable scenarios and integrate them into their classrooms. Therefore, it is suggested that a one-day workshop should be organized with lead teachers to draft the scenarios that can be used by other teachers in the pilots. In addition, it is suggested to have at least one case study from each country to generate qualitative evidence and to gain deeper insights into the specific national context and to cover aspects that cannot be identified by questionnaires. (Point 3.2 of this document).

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3 PILOT DESIGN

3.1 SPECIFIC ENVIRONMENTS

The pilot learners in the ORT consortium are already using digital work environment to access resources, which are stored on a server. As far as STEM are concerned, those learners have used the EAST programme (a model learning scenario using 3D elements and focusing on the digital use of STEM for secondary school students), that is linked to the creation of practical work in the field of energy and sustainable energy and using simulation tools. Those students have therefore experienced learning within a Learning Management System.

The approach through games helps students to learn better and follow the lessons. It is an approach particularly interesting and effective for NEETS. While the students are playing, they are indeed working and practising skills. It stimulates their learning motivation and helps them analysing hypothesis to find the right solution, while going at their own pace.

Two phases of testing are organised: the first one to learners who never used BEACONING and the second one to learners who have worked their STEM on BEACONING. The educators can compare the gain or the overlap between the two groups. This can be done through a similar assessment in the two groups.

BEACONING is an alternative to traditional Learning Management System, and complementary to traditional methods of education. And in order to determine whether DLS and their games can indeed be an alternative to traditional LMS, learners need to be tested in formal learning environments.

The pilot guidelines present a method to establish permeable and flexible pathways across these categorical environments using BEACONING technology. In similar manner, the BEACONING pilot guidelines would also be able to help conduct trials to determine the transitional capacity and capabilities offered by BEACONING, e.g. primary-secondary, secondary-tertiary (HE), secondary-VET-HE, etc.

3.2 SCHOOL LEARNING SYSTEM

In order to integrate in the best way the small-scale pilot in the classroom, it is important to define the learning context and school learning system in the consortium. From that perspective, we need to answer those following questions:

3.2.1. The deployment of digital learning in education. (use of digital space, resources, courses, games..)

3.2.1.1 In formal education on STEM

In France, a wide range of initiatives are introduced at the national level for building digital skills in schools. A summary is presented below [**Error! Reference source not found.**][**Error! Reference source not found.**][**Error! Reference source not found.**].

A digital space of work (ENT for "Environnement Numérique de Travail**")** has been opened by the French ministry of Education and is being deployed since 2012.

This space of work (https://www.parisclassenumerique.fr/lutece/jsp/site/Portal.jsp) is a set of digital services proposed to school establishments and its educative community;

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Pupils, parents, teachers, administrative staff can access those digital work spaces from any internet connected computer.

Partnerships between education authorities and regional authorities enable the deployment of those spaces. Every regional education authority is committed in at least one digital space project, to different stages: spread, experiment or study case.

The digital homework notebook is compulsory in all secondary schools in France. It is a space of work accessible online through the digital work space (ENT) or the school website. Each class or each pupils group has got their own notebook, according the time table. It is considered as an official document. Once it is completed by the teachers, pupils and parents can consult it online.

Use of touchscreen tablets in the classroom, a new way to teach. Several regional authorities have provided secondary schools with tablets, in order to test its use at school or at home. Authorities of Bordeaux, Créteil and Grenoble have launched a testing in 2012, with the support of the education Ministry, giving touchscreen tablets (IPad, Achos, Samsung or Acer + Wi-Fi router) to pupils.

Serious games: a new learning medium. In 2012, several educational authorities in France, like Créteil or Aix-Marseille, were committed in the testing of serious games in class, with the support of the French ministry of Education. The aim was to analyse the impact of such a material for pupils aged 10 to 19 years old. The topics of the games were science, maths, civic and social education, physics, technology and individual support. 96% of the teachers estimated that the serious games gave an added value to general education and 86% of them concluded that it gave an added value to their subject.

With the success of this testing, works are now in process to identify resources that can satisfy the needs of the teachers and the pupils, and a programme of good practices that can guide the teacher to help them controlling these teaching resources.

In terms of content, many serious games are dedicated to sustainable development. The following games have been selected by the French Education for their concept:

- Clim' Way (http://climway.cap-sciences.net/);
- La cascade (http://www.eau-rhin-meuse.fr/hector/rub-cascade/jeu-cascade.htm);
- Le défi d'Hector (http://www.eau-rhin-meuse.fr/hector/rub-defihector/defi.htm);
- Une journée au fil de l'eau (http://www.conso.net/clara_noe/index.html);
- Haya (http://www.kailis-design.net/haya/haya.html);
- Catchment detox (http://www.catchmentdetox.net.au/play-game/);
- Thot Cursus (http://cursus.edu/institutions-formations-ressources/formation/16184/jeux-serieux-gratuits/#.VxpBX3qWEuf) is also a collection of serious games.

Stimulate a responsible use of digital network and services. The education ministry has set up the « responsible website », in order to guide teachers and pupils in the new functions of Internet. It gives a unique access towards resources which foster the responsible control and use of digital network and services. It suggests an access to regulations, practical guides, and news on ICT at school.

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Examples of important digital services for students introduced since 2013. The following services have introduced significant educational value for learners.

- "Basics in primary schools": a collection of hundreds of animated films lasting 3 minutes (free online access), to understand, in a recreational way, the basic notions of learning French and mathematics;
- "English for schools": a service learning digital resources for 8-11 years old for a funny style of learning English at home and in class;
- D'Col: a service of interactive and customized support in French, Mathematics and English, for 30 000 pupils in CM2 and 6th class (10 years old, last year in primary school and 11 years old, 1st year of secondary school) on a proposal from the establishment and with the parents' agreement. It is part of the programme "priority education" and aims to help pupils in difficulty. Those pupils can then have an online support up to 2 hours a week;
- Prep' exam: an online access to both "brevet" and "baccalauréat" exams, to help pupils getting prepared for those exams.

In Romania, they still have the digital space offered by AeL eContent content which has a consistent structure – text, assessments and interactive animations, as well as presentation movies have a well-established place on the screen in each learning object, according to psychologists' recommendations. Information and icon objects are also well positioned, for ease of access and redundancy avoidance.

AeL eContent is organized in reusable learning objects (RLOs) that are structured in learning content packages. The main idea of 'learning objects' is to break educational content down into small chunks that can be reused in various standard-compliant learning environments. The concept of content re-usage is based on description formats of the XML packing, having the necessary elements, in order to import and export conformable the MathML, SCORM and IMS standards.

In Romania we are using the following resources:

- Virtual labs covering the mandatory experiments from the National Curriculum for Physics, Chemistry and Biology (http://escoala.edu.ro/).
- Electronic lessons - AeL eContent is one of the largest and most exciting digital libraries in the world, AeL eContent can be translated in several languages and localised to respect the educational and cultural background of any country/region. (http://portal.edu.ro/bacalaureat/, http://portal.edu.ro/gimnaziu/, http://portal.edu.ro/primar/)
- Portal ISE- Inspiring Science Education - ISE provides digital resources and opportunities for teachers to help them make science education more attractive and relevant to students' lives. Through the Inspiring Science Education website and the activities organised by the partners, teachers can help students make their own scientific

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discoveries, witness and understand natural and scientific phenomena and access the latest, interactive tools and digital resources from within their classrooms (http://inspiringscience.eu/).

Technology is progressing. Science drives its development. New jobs appear every day on the labour market, some we haven't even thought about. Many of today's students will do these jobs. They probably won't be trained for these jobs since they haven't been invented yet. However they will learn somehow.

"Nothing is more important in the twenty-first century than learning to manage change." (Fullan, 2008).

But for this to happen, their thinking and knowledge must be adaptable. The skills they acquire in school should allow anchoring in the real world.

On the other hand, the teachers' role is changing from keepers of knowledge to facilitators of learning. Many teachers are comfortable delivering information. They view themselves as the keepers of the keys. But our job as educators is to facilitate learning.

Applying the principles of continuity and consistency in the school education reform in Romania in the STEM area shifts the focus of the educational process towards the acquisition of skills and abilities.

The teacher's role in interactive training is to propose students activities which actively get them involved and determine them to unlock and fulfil their potential looking for something new, and achieving it through their own intellectual efforts. The major objective in interactive training is focusing on individual or collaborative learning activities, the teacher helping his students to shape personality, to develop their sense of responsibility and self-confidence.

In the UK, The Department of Education (DE) and the Department of Employment and Learning (DEL) in the UK has recommended some strategies based on the Report of the STEM review[1], aiming to empower future generations through science, technology, engineering and mathematics to grow a dynamic, innovative economy. Specifically, there are concerns around the key constraints in the STEM artery that have to be alleviated. Strategy includes providing support from a lower level education - primary school teachers in teaching the area of learning. This also includes the ongoing review of the developments in mathematics in relation to STEM provision. One recommendation is for STEM learning to be made more enquiry based. Therefore, in commissioning new resources for primary schools, DE emphasizes on enquiry-based learning and on providing pupils with opportunities to develop their thinking and problem-solving skills.

It is also emphasized that there is potential to link in with the work being done on STEM curricula at primary, secondary, further and higher education, establishing a streamlined system where STEM is made appealing at all levels. There are issues with the perception and confidence in STEM education. The report suggested that children develop negative attitudes to science in primary school and many primary teachers lack the knowledge, skills and confidence to deliver a science and technology programme, which develops progressively the children's skills and knowledge. There may also be a disjoin between Key Stage 2 and 3 meaning that pupils often

[1] https://www.education-ni.gov.uk/publications/report-stem-review

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repeat work which they mastered in primary school, which leads to the perceived difficulty of these subjects at Key Stage 4.

There is therefore a need for increased flexibility in the provision of STEM education, focusing on the core sciences and mathematics subject in the UK based on the strategy. DE stresses on a clear focus on attainment in mathematics from Key Stage 1 to GCSE recognising the importance of mathematical skills as the basis for learning in all STEM-related subjects. Therefore, its recommended that an interest in core sciences and mathematics subjects is inspired, encouraged and promoted, where the education sector needs to make more effective use of the innovative STEM related resources, expertise and learning opportunities. Furthermore, it is also important to develop a STEM continuing professional development (CPD) framework to ensure the provision of professional development opportunities for teachers that are designed to promote and support effective STEM teaching in the primary and post-primary sectors within the revised curriculum and to disseminate best practice.

A report focusing on engineering education –The UK STEM Education Landscape report[2] published by the Royal Academy of Engineering synthesises some issues affecting engagement in engineering beyond age 16, which will also be relevant for the other STEM areas and reflective of the STEM review, which includes poor perceptions and attitudes towards engineering careers among young people and their influencers, the need for more teachers to engage in professional development that improves their understanding of the application of science and mathematics to real-life contexts as well as issues with facilities and capacity across the whole education landscape.

According to the report[3], there are over 600 UK organisations carrying out initiatives that aim to engage schools with STEM. The report highlights that, "*despite more than 10 years of concerted effort, all this activity has not yet had the desired impact of increasing uptake of STEM subjects among young people. The report calls for future initiatives to be far more co-ordinated, with better evaluation of their long-term impact.*"[4]

One of the active organisations is the Stem Learning UK[5] that facilitates the sharing of resources for teaching STEM subjects from primary and secondary through to FE and HE. It is the largest provider of STEM education and careers support to schools, colleges and other groups working with young people across the UK. Supported by a unique partnership of Government, charitable trusts and employers, the Network is dedicated to raising young people's engagement and achievement in STEM, and increasing the numbers of young people progressing in STEM studies and STEM-related careers. We provide teachers, school technicians and others working with young people with; STEM-specific, career-long professional development; access to free of charge, curated curriculum resources, STEM Ambassadors; STEM Clubs support; and a wide range of engaging activities with proven impact on outcomes for young people. We work with employers of all sizes to help them maximize the return they get from their investment in working with young people, teachers and schools.

One of its initiatives, the STEM Ambassadors, involves volunteers from a wide range of science, technology, engineering and mathematics (STEM) related jobs and disciplines across the UK. The volunteers offer their time and enthusiasm to help bring STEM subjects to life and demonstrate

[2] http://www.lrfoundation.org.uk/news/2016/stem-report.aspx
[3] www.raeng.org.uk/publications/reports/uk-stem-education-landscape
[4] http://www.lrfoundation.org.uk/news/2016/stem-report.aspx
[5] https://www.stem.org.uk/

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their value in life and careers. STEM Ambassadors are free-of-charge resource for teachers engaging with young people in and outside of the classroom.

3.2.1.2 In formal ICT education

In France, the French school system has a dedicated curriculum for the development of ICT skills in primary and secondary education. The ICT curriculum is titled “Le brevet informatique et internet (B2i) », ICT secondary school certificate for pupils”. The curriculum is structured as follows:

In primary and secondary education the ICT certificate responds to the needs of each citizen to be taught on the reasonable use of ICT. This training is a way to detect possibilities and limits of the ICT, and to demonstrate a critical mind.

B2i schools have been set up since September 2012. The schools enable the certification of the acquired level on multimedia tools and internet for each pupil. It also enables to better prepare the pupils to use the ICT in a responsible way.

B2i schools are an educational tool, which takes into account the transformations of digital uses. It is connected to the personal booklet of competences (competence 4: knowledge of ICT). B2i is not a diploma, but a "certificate of competences".

All pupils and apprentices from public schools and training centres are concerned by this certificate. The pupils use the ICT during different disciplines and in diverse circumstances. The acquisition of B2i validates the skills acquired throughout those activities.

Five domains are evaluated:

- Domain 1: Be adapted to an IT work environment;
- Domain 2: Adopt a responsible attitude;
- Domain 3: Create, produce, process, exploit data;
- Domain 4: Inquire, gather material;
- Domain 5: Communicate, exchange.

In Romania, in formal education students have curriculum of ICT which defines the skills and competencies necessary to use a computer and common computer applications. ECDL base modules certify skills that are considered essential skills because they are crucial for anyone who uses a computer to possess:

COMPUTER ESSENTIALS: This module will teach how the essential concepts and skills relating to the use of devices, file creation and management, networks and data security.

ONLINE ESSENTIALS: This module will teach how the essential concepts and skills relating to web browsing, effective information search, online communication and e-mail.

WORD PROCESSING: This module teaches how to use a word processing application to accomplish everyday tasks associated with creating, formatting and finishing small-sized word processing documents, such as letters and other everyday documents

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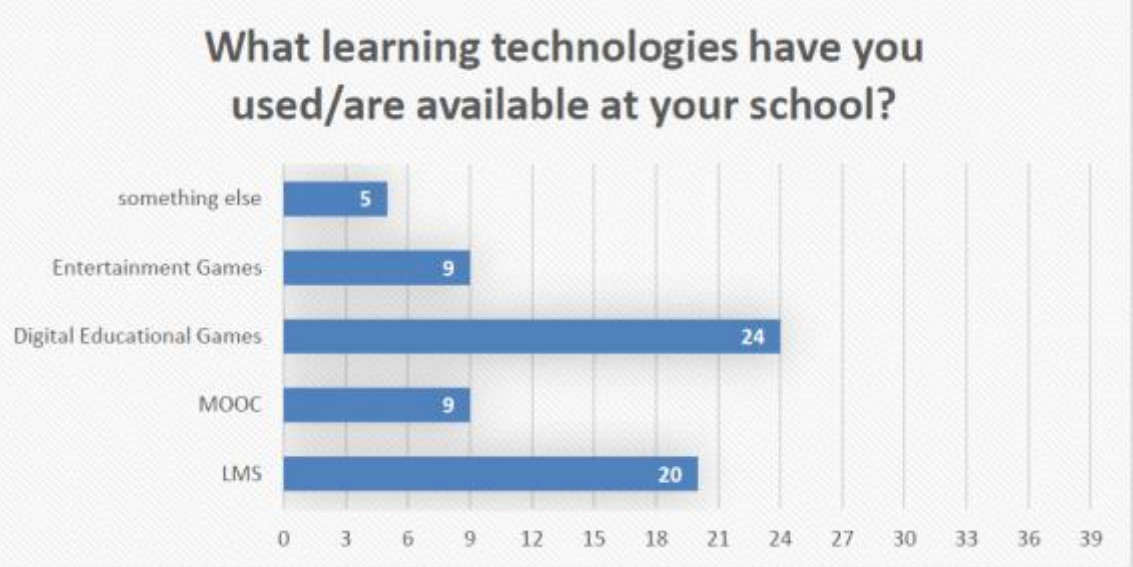
SPREADSHEETS: This module teaches how to understand the concept of spreadsheets and to use a spreadsheet application. It will enable you to perform tasks associated with developing, formatting, modifying and using a spreadsheet, to use standard formulas and functions, and to competently create and format graphs or charts.

Almost 2/3 of the 39 external teachers state that they use digital educational games in their schools. Some of them also make use of entertainment games. Half of the participants use a LMS and 23% use open online courses.



Key Figure 1

In Romania, STEM is an educational concept that is based on the process of training and the education of pupils and students in four areas: science, technology, engineering and mathematics, using a multi-disciplinary and applied approach. The STEM approach integrates these disciplines into a paradigm for instruction based on real-world applications and it aims to revolutionize the teaching of scientific subjects by introducing technology and engineering in the students' activity, the problems being solved through discovery, learning and exploratory training. Now, in Romanian schools, these kind of activities are developed especially during the optional courses or extracurricular activities like contests or science fairs.

In the UK, The Royal Society UK[6] analyzed ICT education in the schools in the UK and based on their 2012 findings, the summaries of the key findings from the report as extracted include the unsatisfactory delivery of computer education. This is mainly due to the national curriculum in ICT that was broadly interpreted and reduced to the lowest level where non-specialist teachers can deliver. The status of Computing in schools needs to be recognised and raised by government and senior management in schools. It is also emphasised that there is a need for qualifications in aspects of Computing that are accessible at school level but are not currently taught.

Since the review, a new computing curriculum for 5-16 year olds has been designed, which was introduced into English schools in September 2014. The subject is called computing, rather than 'ICT', emphasising on coding, algorithmic thinking and computer science, rather than digital

[6] https://royalsociety.org/topics-policy/projects/computing-in-schools/report/

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literacy, typing or elementary software skills. In Scotland, the Curriculum for Excellence that was introduced in 2010 includes computer science contexts for developing technological skills and knowledge. In Wales and Northern Ireland the curricula are primarily focused on ICT.

3.2.2. What are the current practices on the development of STEM in school education in your country? How is learning structured? What are the learning objectives and typical activities?

In France, it is the ministry with responsibility for education as well as other official bodies committed to supporting science education, working in close cooperation with the research and science community, which are behind the existing partnerships. The organisation Sciences à l'Ecole (39) is set up by the Ministry of National Education and the Ministry of Higher Education and Research. Funded by the government and the industry foundation C.Genial, Sciences à l'Ecole supports and organises scientific projects carried out in secondary schools but outside the teaching of science subjects, such as during workshops and clubs. At national level, Sciences à l'Ecole establishes school networks such as Sismo à l'Ecole (40), Météo à l'Ecole (41) and soon Genome à l'Ecole. The national steering committee of Sciences à l'Ecole is chaired by eminent researchers and includes members of the general directorates of research and innovation, of school teaching and of higher education. A permanent group of four teachers and engineers is in charge of the implementation of the various projects. In each académie, a representative, usually, a regional inspector assures the link between secondary schools and Science à l'Ecole. Two partnerships in science education are focused, in particular, on curriculum development and the design of teaching materials for science subjects. La main à la pâte, which means collaborative and hands-on work in French, was founded in 1996 by Georges Charpak, a Nobel Prize winner, and the French Academy of Sciences / Institute of France with the support of the French Ministry of Education. The programme started in 1997 with a partnership between the French Académie des sciences and INRP (National Institute for Pedagogical Research). Agreements in 2005 and 2009 reinforced the partnership between the Académie des sciences, the Ministry of National Education and the Ministry of Higher Education and Research and extended it until at least 2012, while also widening the programme to include students at ISCED. The main objectives are to promote science and technology teaching at school, to train and support teachers as well as to spread inquiry methods at an international level. La main à la pâte has an international dimension with direct partners in 30 countries. In France, the programme is managed by a directorate strongly linked to the Académie des sciences and run by a team established in the Ecole normale supérieure at Montrouge. There is a network of 14 steering centres which implement the programme and five associated centres responsible for building projects and partnerships with schools (57). Based on ten principles, the strategy of La main à la pâte stresses science, language and social skills. Pupils and students progressively appropriate science concepts and methods and improve their oral and written communication. Different professionals from the field of science and education, for example, teachers, teacher educators, inspectors, students, engineers and scientists participate in the development of the various teaching materials produced.

In Romania, the actual school STEM (especially science) curricula do attempt to serve two goals – that of preparing a minority of students to be the next generation of scientists – and that of educating the majority in and about science, most of whom will follow non-scientific careers. For the future scientist, their education best begins with the fundamentals of the discipline. In this approach, only students who reach a relatively high level of education in science develop a sense of the explanatory coherence of science and its major ideas.

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Yet it is this latter understanding – good examples of which can be found in the better quality of popular science writing – which everyone requires. Asking the school science curriculum and teachers of science to achieve both of these goals simultaneously places school science in tension where neither goal is served successfully.

On the other hand, STEM is a curriculum based on the idea of educating students in four specific disciplines — science, technology, engineering and mathematics — in an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications.

What distinguishes the STEM model from traditional education is the cohesive learning that shows pupils and students how the scientific method can be applied in everyday life by developing the type of thinking based on the real life application of solutions.

What separates STEM from the traditional science and math education is the blended learning environment and showing students how the scientific method can be applied to everyday life. It teaches students computational thinking and focuses on the real world applications of problem solving.

In Romania, we are practicing now some optional courses like: Learning into the Knowledge Society, Education for Health, etc. They are based on Project-Based Learning.

In the UK, from the age of five, children in the UK enter the formal education system and progress through a series of stages and transition points (e.g. GCSE and A-Levels). They will remain in some form of education, or training until at least the age of 18. Throughout this period, they will travel through a formative period of education and personal development during which they will be exposed to a range of social and educational influences and experiences.

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The curriculum in England, Wales and NI

The National Curriculum specifies the terms shown below. National examinations take place in the years shown in bold: SATs are taken in Y6 (English and maths - science was scrapped this year); GCSEs (and other qualifications) are taken in Y11; A-levels are taken in Y13. Additionally, in KS1 there are Teacher Assessments in English, maths and science. AS-level examinations are taken in Y12: these have not been a success and are likely to be scrapped in a major review of the post 16 curriculum in 2012.

Age		Key Stage	Year	Phase
18+				Further Education
17-18			Y13	
16-17			Y12	
15-16	compulsory education	KS4	Y11	Secondary Schools
14-15			Y10	
13-14		KS3	Y9	
12-13			Y8	
11-12			Y7	
10-11		KS2	Y6	Primary Schools
9-10			Y5	
8-9			Y4	
7-8			Y3	
6-7		KS1	Y2	
5-6			Y1	
4-5		EYFS	R	
0-5				Pre-school

Figure 2 Key stages in formal education in the UK[7]

According to the UK STEM education report[8], "*each year, some 650,000 students across parts of the UK (England, Wales and Northern Ireland) take GCSE exams across a broad range of subjects. Of these, around 300,000 will achieve a 'good' grade (A*–C) in maths and two sciences – usually seen as the minimum required for progression to further study in STEM subjects at level 3 (A level or equivalent vocational qualification). In reality, many schools require students to have an A/A* grade in maths and physics to allow students to progress with STEM subjects beyond 16, because of concerns about the transition from GCSE to A level and consequent impacts on school performance measures*"

The report also synthesizes that "*of those students who do achieve good grades in maths and science at GCSE, around 90,000 now go on to take maths A level. Over the same period, all science subjects have also been increasing at A level; however, their growth has been relatively slow and the number of students taking physics remains stubbornly low. Only around 30,000*

[7] http://www.educationimpact.net/media/23170/bett-2011-a%20guide%20to%20ict%20in%20the%20uk%20education%20system.pdf
[8] http://www.lrfoundation.org.uk/news/2016/stem-report.aspx

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students will choose to pursue a combination of both maths and physics at A level – often seen as a requisite combination for entry to many engineering and physics degree programmes."

There are two schools which are going to be engaged in the small-scale pilot with considerations of the recommendations discussed for STEM education in the UK. Even though the BEACONING main target audience is between 16-24, there is a need to link work being done on STEM education at primary, secondary, further and higher education, establishing a streamlined system where STEM is made appealing at all levels. Therefore, for the UK Stem pilot, we are engaging with Howes Primary School and King Henry VIII Senior school. These schools are open to exploring new ways of teaching STEM subjects, for instance Howes is involved as part of the Scientix ambassador programme, where they have set up a future classroom as a lab to explore STEM education in the school. Based on the existing engagement with the school, they are mostly concerned about the level of mathematics education and attainment, which will influence the lesson paths to be developed with them. King Henry VIII's has been very active with the use of VEX and Lego Mindstorms robots as part of the co-curricula, which will be exploited as part of the Coding and Robotics lesson path developed in BEACONING.

3.2.3. What is the typical ICT infrastructure for a school?

In France, as far as equipment and infrastructure are concerned, there is an imbalance between primary and secondary schools. In 2015, in a national inquiry, out 2500 primary school teachers and 5000 secondary school teachers, 30% of them use ICT for their courses, 60% use it in class, mainly for languages, reading and mathematics, but unfortunately they can't use it on a daily basis, due inadequate equipment and high-speed.

Among the equipment financed by their school and that they can use at home, 7% of the teachers have got a computer, 11% a laptop, 2% a tablet, 2% a smartphone with Internet access.

The equipment that is easily at the disposal of the teachers at school are printers (68%), digital cameras or videos (47%), computer or tablets for teachers (47% in primary and 82% in secondary), computers for pupils (45% for primary and 53% for secondary), interactive tables (30%), video projector (38%), mobile class (16% for primary and 6% for secondary), tablets for pupils (3%).

The typical ICT infrastructure of a Romanian school consists of one or many computer labs with networks of 10-25 or 30 desktop computers connected and with internet access. In some schools there are digital classrooms where students come with their own devices (laptops, tablets, etc) and they are using them during formal and informal education.

Referring to Deliverable 3.1 and based on the results of questionnaires to 16 school administrations, almost 70% of participants use digital educational games in their schools. Half of all respondents use an LMS (i.e. much lower than in the internal, with 100%), whereas MOOC's, ARLs, e-learning and video/audio materials are hardly used. The diagram below shows that the majority of schools have laptops in their schools followed by desktop computers, tablets and multimedia. Only a few use various devices like smart boards, smartphones, networks, webcams and printer in their schools.

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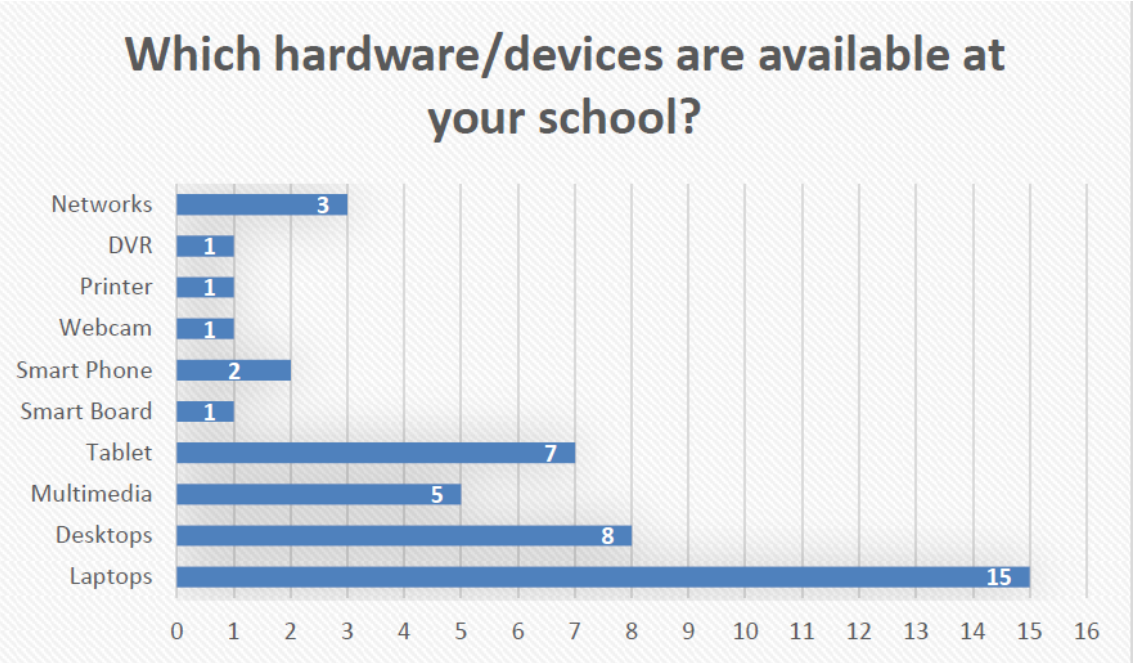

Key figure 3

In the UK, a school in the UK is often equipped with audio visual equipments in a classroom and computer laboratories.

According to the report on the ICT in the UK Education System[9] in 2011, "*the average number of pupils per computer in schools has changed little over the past few years. The median number of learners for each computer in primary schools 6.9 and in secondary schools is 3.4. 65% of primary schools and 63% of secondary schools consider themselves to have good computer access for learners. This compares to around 25% for primary schools and 18% for secondary schools in 2005. Only 5% of primary and 2% secondary schools consider themselves to have little access for learners. Classroom technologies are extensively available in schools, especially primary schools. Teachers and ICT coordinators broadly agree about this extent. Most teachers however do not have access to handheld devices (PDAs), netbooks or mobile phones within their schools- based on BECTA 2010*" OFSTEAD has also provided a survey of ICT provisions for 2008-2011[10], which is the most recent analysis carried out for the DE.

The provision of ICT infrastructure has improved from 2011, with most schools connected to broadband, utilizing learning platforms and various devices (mobile, etc.). The British Educational Suppliers Association's (BESA)[11] surveyed 'ICT in UK State Schools' and they found that learners are currently exposed to ICT for 53% of teaching time in comparison to 50% in 2014. "*The 609 schools surveyed (294 primary and 315 secondary) forecast that this exposure will continue to rise, with pupils expected to use technology for 58% of learning time by 2017. The UK has always led the way in terms of the use of technology in education, with many*

[9] http://www.educationimpact.net/media/23170/bett-2011-a%20guide%20to%20ict%20in%20the%20uk%20education%20system.pdf
[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/181223/110134.pdf
[11] The British Educational Suppliers Association's (BESA)

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thousands of educators from schools overseas attending Bett, the world's largest technology in education event, each year." [12]

In Turkey, as far as ICT in education is concerned, MoNE has long valued its integration in classrooms, and various efforts have been made to provide schools with access to computing equipment and interactive teaching technologies. For example, the World Bank supported Basic Education Project implemented between 1998 and 2004 aimed to improve basic education quality by providing computer labs and educational materials to schools. Within the scope of the project, computer equipment was provided to 2,802 classrooms and ICT trainers and coordinators were trained. However, the World Bank notes that insufficient computer software was provided to the schools; the actual courses taught by the ICT trainers were limited to laboratories and focused on basic computer skills. Additionally, subject teachers were not trained in how to integrate computers into their subject teaching. It should be also noted that Turkey's first ICT in education intervention was implemented without an official ICT policy paper, which was not available until July 2006. This policy paper entitled Information Society Strategy (2006-2010), which was in place when F@TIH was conceived, suggested that widespread introduction and use of ICT was considered as one of the primary means of maintaining sustainable economic growth. This would involve increased spending on physical infrastructure and also "building human capital that will exploit these technologies effectively." Since 2011, at least 63 thousand tablets were distributed to students and 84 thousand classrooms were equipped with interactive whiteboards (IWB) as part of initial distributions.

Within the F@TIH project framework, LCD interactive smart boards and tablet PCs will be provided for all classrooms, as well as a purpose-designed network infrastructure. In-service training will be provided for teachers to enable them to use and adapt ICT tools and resources efficiently within their teaching and learning processes. For supporting the project, a web portal named EBA (Egitim Bilisim Agı (tr) – Education and ICT Network) is designed in order to address both teachers' and students' needs. F@TIH's first distribution phase excluding tablets began in the 2010-2011 school year in four schools. Each classroom in these schools was equipped with a laptop, a projector, and an Interactive whiteboard. The second distribution phase including tablets was completed in 17 provinces and 52 schools in 2012-2013. During this phase tablets had only intranet access with limited coverage determined by MoNE. Following the second phase of distribution, MoNE decided to grant Internet access to tablets while in schools. The specific modalities for ensuring equitable access to the Internet after school hours and at home are still under development. Within the F@TIH framework 680 thousand teachers should receive two modules of training. Starting in 2012, implementation of 30-hour trainings on ICT use in education and 25-hour trainings on preparatory education were launched. According to MoNE, more than 120 thousand teachers received training as of April 2013. MoNE has also established 110 distance learning centers in 81 provinces, which will facilitate teacher access in the future.

There is a perception both internationally and locally that F@TIH is largely techno-centric because of the scale of the initial investment of 570,000 IWBs and accessories and 10.6 million tablet computers in the first three years alone. Yet the project components above do recognize that in addition to hardware, teacher training and content must be addressed. Furthermore, although F@TIH is best known for its one-tablet-per-student aspect of the hardware

[12] http://edtechnology.co.uk/Article/ict-use-in-schools-on-the-rise

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deployment, it is equally important to note that it also includes an IWB per classroom. The goal of equipping schools with technology—particularly IWBs and computer classrooms—predates F@TIH by over a decade in Turkey, as described above. However, previously, schools had to fundraise locally for ICT equipment; as a result, schools in wealthier communities were better resourced while other schools remained marginalized. The word "opportunity" in the acronym F@TIH refers to the effort to counter this trend and ensure that all schools and students have comparable opportunities.

3.2.4. What opportunities do teachers have in your country to build their ICT skills through professional, continuous, or other educational initiatives?

In France, All teachers are concerned by the use of ICT tools and their integration in teaching practices. Unfortunately, 90% of the teachers have built their ICT skills themselves, 30% with the school training (initial or continuous), and 7% with an online training.

At the end of university curricula, i.e. initial teacher training, every new teacher must have acquired the ICT skills related to his professional practice.

Expected knowledge and capacities are related to the skills of the "ICT *« teacher »* certificate level 2" (« C2i2e »), attested in the framework of his master degree.

The following are examples of training opportunities for teachers in France:

- M@gistère (https://magistere.education.fr/) is a continuous learning and interactive platform conceived for teachers in primary and secondary schools. It is complementary to the existing training;
- FUN (www.fun-mooc.fr), Viaeduc (http://www.viaeduc.fr) and CANOPE (www.reseau-canope.fr) are public online resources platforms for teachers: it provides teachers with educational digital resources;
- Ludovia magazine (www.ludovia.com) is an online media about educational digital technology and the use of digital technology in class, from primary to university level. The articles of this magazine give the orientations that are not yet generalised in France, but developed on an experimental level in secondary schools;
- Eduthèque (http://edutheque.fr)is a portal that provides free online resources from big public establishment in scientific and cultural fields;
- Read, a year of reading learning (www.cndp.fr/lire-au-cp/) is a web documentary to help teachers and parents to support the children in first year of learning to read;
- My second chance (http://www.masecondechance.fr), my online internship, my industry (http://monindustrie.onisep.fr) are services to help pupils in situation of dropping out of school;
- Total Accès (http://mobile.onisep.fr/totalacces) is an application for vocational insertion and orientation.

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Key figures on teacher digital training in France:

- 9 teachers out of 10 are convinced of the ICT interests to diversify practices, to prepare courses and made them more attractive;
- Almost 80% of the secondary schools have a project related to digital technology.

In Romania the teachers had the opportunity to learn and to certify their ICT skills during some Operational Programs (POSDRU), where they sustained ECDL (European Computer Driving Licence) examinations and could receive a computer driving licence.

Some other initiatives where:

ICT-Based Education System: SEI Programme in Romania;

ICT- Based education: Knowledge Based Economy.

In the UK, teachers are supported by various organisations such as mentioned in the UK STEM Education report. The STEM Learning UK for instance is playing a key role for providing new resources and training to teachers, which also include ICT skills.

In Turkey, There are in-service training opportunities for teachers, organized and implemented by the ministry of National Education especially about F@TIH project recently. It is one of the main components of F@TIH project and it is obligatory to attend these in-service trainings for public school teachers in order for them to develop digital skills.

Local and international technology companies hold workshops, certificate programs and camps for developing teacher's digital skills outside of school. They aim to use technology in a most useful way in the schools they have visited. These companies cooperate with universities and they have executives working on technology education to provide support in the development of integrated curriculum.

There are also conferences, aiming to share good practices in using technology in education every year regularly. Schools share their good practices, experience and skills in using technology actively by their presentations and workshops. Conferences also aim to pave the way of information exchange in later on by the connections between schools, which will be set up during the activities in a next stage and sustain this information exchange. Schools have the chance to know about new technologies by visiting and interacting with the booths of technology companies in conferences.

Development of digital skills is essential for both governmental and private schools as most of the activities in the modern world are technology based nowadays. A system that does not innovate itself and does not adapt itself according to the features of the term, rests behind in all aspects including education. Learners' needs of and the role of teachers have definitely changed especially during the most recent years. The new age children are fond of using technological devices and this feature should be integrated into education system also. Because of this desire, as mentioned above with the F@TIH project (Movement to Increase Opportunities and Technology) the classrooms' outlook towards the technological era is gradually changing thanks to the addition of interactive whiteboards and internet web service. However, there still seems to be a gap between the initial implementation and expectations of the project and its current situation which is somehow distant from the planned program.

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In the formal school system web 2.0 tools are currently supported for use by the teachers and students. These tools are boosting the learning potential and offer advantages for both teachers and students. Web 2.0 enables [107]:

- Socialisation - Through socialisation our students can use the language and skills they are learning to build networks and develop relationships with real people.

- Collaboration - They can work together with others to construct and share real knowledge.

- Creativity - They can create genuine products, in a wide range and combination of media to high standards, that will have a real audience.

- Authenticity - The tasks and activities they do and the people they communicate with to do them are real and motivating.

- Sharing - They can share what they create and learn from each other.

Especially EBA portal is the one related with F@TIH Project and is used and supported by the Ministry of Education. It is reported that more than 150000 contents are uploaded to the EBA (Eğitim Bilişim Ağı/ Education Informatics Web) portal. In this portal (EBA), many digital sources are prepared by Ministry of Education and volunteer training companies and also other products offered by teachers and students. Therefore, it is created a pool of resources and learning will be presented to the every learning enthusiast. That training has the aim of being an integral part of life while the portal has the aim of enabling the students to decide and organize learning on their own. Besides that, the students will get used to peer cooperation and teamwork. It will be easier to switch from teacher-centered education to student-centered education with the portal and as a result a new generation, able to research, interpret, form personal opinion and construct knowledge from information will be raised. The aims of EBA portal [108]:

- To provide rich, different and educational content;
- To provide the usage of informatics in the education field;
- To contribute to the school courses with a rich and growing archives;
- To provide exchange of information with its social networking;
- To restructure and generate knowledge from the information;
- To involve the students with different learning styles (verbal, visual, digital, social, personal, visual learning).

Adding to formal school system there are also extra efforts for improving and trying to create an additional value on the process of gaining digital skills. In Turkey, especially the local municipalities feel great responsibility to improve the conditions of life of their people including children, youth and adult formation in the social, cultural, physical and educational fields. Every Municipality has public courses for free in different fields for the ages of 8-14 and for the adults also. These courses are implemented by the Culture and Art Centres and Information Houses of the district administrations. There are courses for the children, young and adults in various fields like drama, musical instrument courses (piano, guitar, violin, drums etc), paper marbling, ICT courses etc. It is hard to say how many Cultural Centres and Information Houses there are in Turkey in total but it may be said that it differs from municipality to municipality but it is tried to set these buildings as many as to make those close to the public. To give an example, there are approximately 5 or 6 Information Houses in each district, out of totally 39 in Istanbul Metropolitan City. Explaining why Information Houses are built and used for, it may be said that

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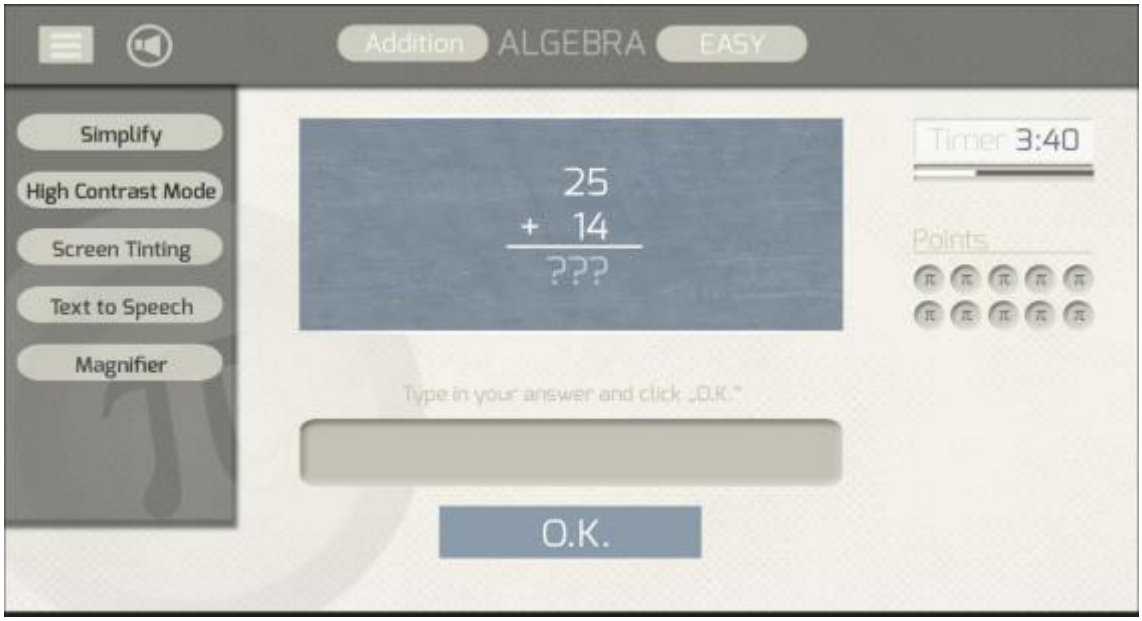
they are for the aims of building a safe and controlled area for the students to study their lessons, boosting the habit of reading books, giving the opportunity of access to internet and computers to the pupils especially deprived from it, to help boosting a social and cultural life, showing better ways to spend the free time creatively.

3.3 TOOLS

This section refers to D4.8, where the gamified lesson paths and the associated components are described.
The small-scale pilot will use digital work spaces and mini-applications:

- Teachers' dashboard;
- Mini-games: solve-it (see figure below), stem-ninja, checkers, bioshock, Find into the Grid, Situational, Word-o-copter, Grid, Robot Simulator, Tower Defense, Line up, Line up variante, Dark Nebula, Generic Quiz.



- Beacons and geopositioning (see figure below) through the following activities : follow the path, capture the flag, Treasure Hunt, Scout, Rat race, Conquest, Jigsaw

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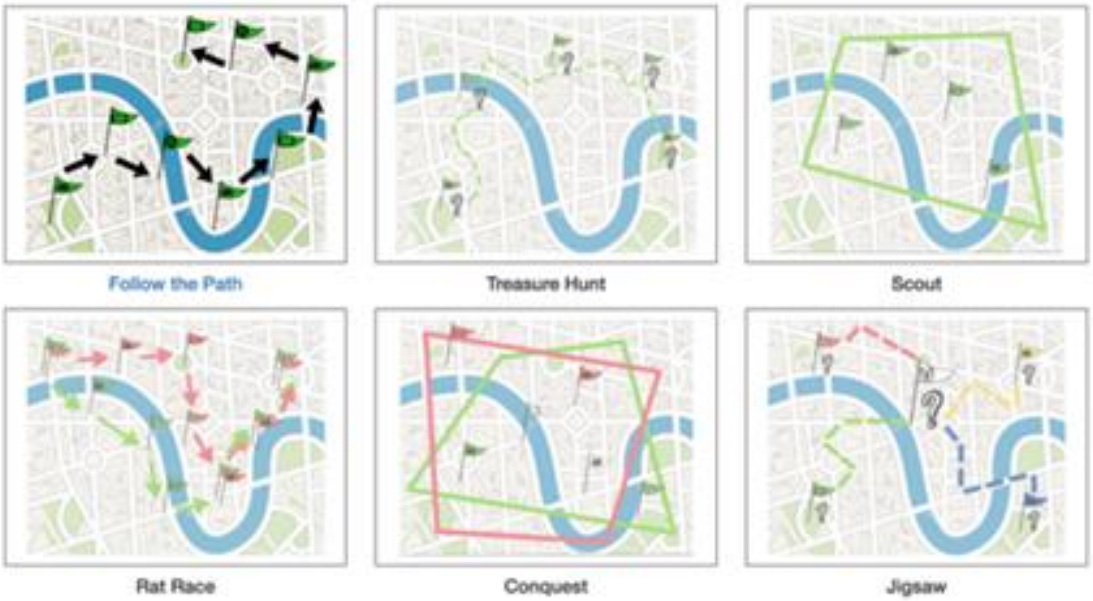

The results from this work are contained in project deliverable D6.1 Evaluation guidelines.

The small scale pilot will use the authoring tool as an integration test:

- Through the tool for students - the following tools will be analysed: the classroom, lesson plans and the library;

- Through the tool for teachers - the following tools will be analysed: classes, ressources, reports, authoring, calendar, messages, search, settings, assistant.

  In the Home page, the instructors will also use the „add mission/quest", „manage classroom" and „assign mission / quest" activities towards their students (see figure below).

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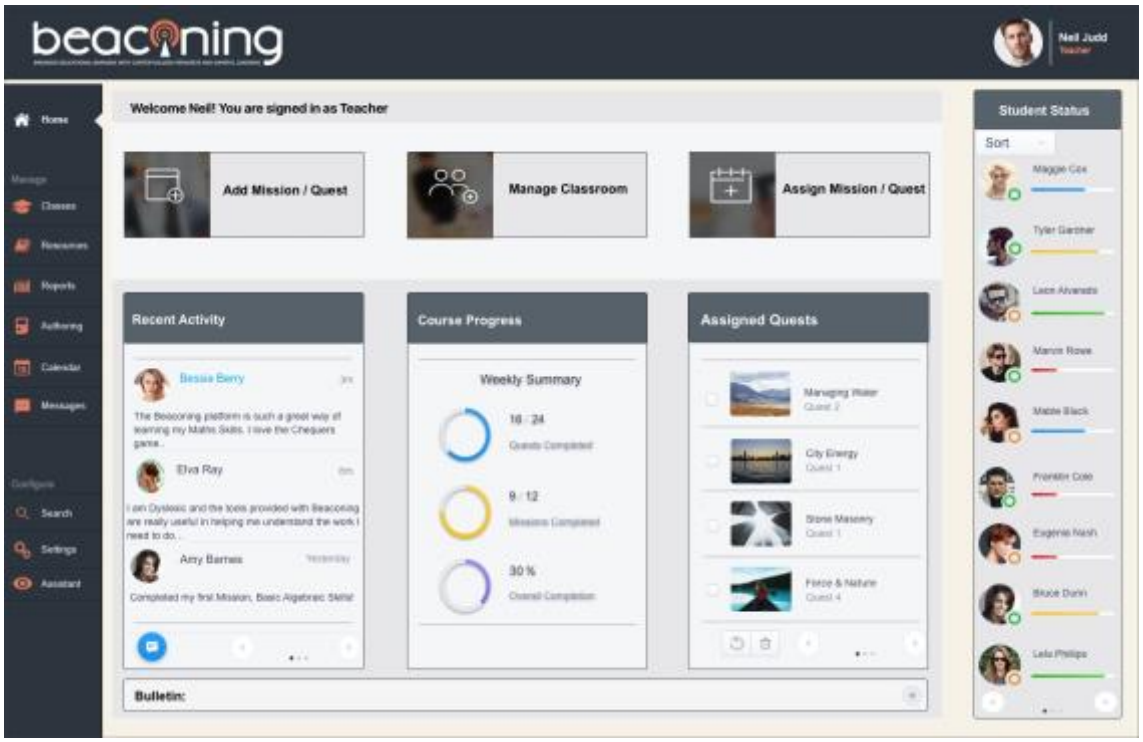

There will also be external tools:
In France, our pilot intends to use the Graasp platform from the European project “Go-Lab”, lead by Scientix. This Learning Management System suggests a number of activities in STEM to be selected and in which the teachers can write their own scenario and incorporate the link to the selected STEM activities.

The Sebit pilot in Turkey will take inspiration from the iTECH project (Innovative Technologies for Engaging Classrooms, 2010-2014), led by the European Schoolnet and where we can find various STEM activities, some of them being already gamified. http://itec.eun.org/web/guest/scenario-library and use the Minecraft system.

Our consortium is having different procedures: we all have a core curriculum, but the tools for students will be localized, and if needed, according to their level.

3.4 SMALL SCALE PILOT EXAMPLES

In this part, each involved partner describes their pilot at their local level.

3.4.1 ORT example in France

Goals	Organized in three parts, the aim is during a set of workshops for Teachers to : - Introduce the BEACONING concepts and learning Paths - To create/refine the learning paths and practice them as if they were Students - Collect Feedbacks - Use the learning paths with students and visualise the results (evaluation)

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Target	Ort schools: 2 schools : Montreuil and Strasbourg
Expected Number of Teachers	10 Teachers
Expected Number of Students	30 Students
Context	1. utilizing digital content, services and platforms to improve inquiry/problem-based STEM education 2. enhancing engagement in science education among the young population 3. Teachers Practicing with the BEACONING tools by : - Creating a set of learning paths; - Entering them in the Authoring tool; - Collecting feedbacks related to the Authoring Part; - Running the learning paths as if they ware students; - Collecting feedbacks related to the Student Part and the DashBoard part; - Refining their learning paths; - Running the learning paths with real students; - Collecting final feedbacks from students and teachers.
Technical Setup	A dedicated BEACONING Lab composed of: - A Classroom with a set of computers accessing the BEACONING platform from the Internet; - A set of devices for using the Students Applications; - A set of Beacons to be implemented in the classroom lab.
Extra Resources (indicate if it is proprietary)	Graasp, Legomindstorm, etc.…
Time & Duration	2 to 3 series of Workshops of a duration of 2 days
The Game	The BEACONING Learning Paths Games
The lesson plan	At least two lesson Plans: - The Basic algebraic skills; - The one related to coding and robotics. Plus the creation/Refinement of existing lesson Plans by the authoring team.
Evaluation Tool	EVALUATION FRAMEWORK FEEDBACK COLLECTION tool

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National Coordinator	François Mohier
Inclusion	Discussion and experimentation with accessibility features

3.4.2 Coventry example in the UK

Goals	• Introduce Play & Game Based Learning in general; • Introduce Game design fundamentals; • Introduce Pervasive Games & learning; • Showcase the BEACONING Ecosystem; • Facilitate teachers in co-designing BEACONING pervasive learning paths; • Test pervasive learning paths with students.
Target	• Howes Primary School; • Cadbury Sixth Form Training College; • King Henry VIII Senior School.
Expected Number of Teachers	20-30 Teachers participating in showcases, 10-20 actually involved in workshops and training days
Expected Number of Students	(Estimated) a total of 10-20 students

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Context	During preliminary workshops, teachers will: 1. Experiment and explore opportunities for integrating play- and game-based learning in the curriculum. 2. Teachers getting acquainted with game design practices. 3. Teachers practicing with BEACONING tools by: • Designing pervasive learning paths; • Entering them in a mock-up authoring tool; • Discuss authoring dynamics; • Experiencing and refining learning paths; • Create pervasive learning paths. In a second moment, teachers will explore the BEACONING tools with students by: • Entering the created paths in the actual authoring tool; • Provide feedback on the actual authoring tool; • Obtain permission from parents; • Run the paths with students; • Collect feedback from students; • Further refine learning paths.
Technical Setup	For the workshops: a paper based mock-up of the BEACONING authoring tool. For the field pilots: BEACONING application installed in School ICT Labs and (obtained parent permission) on Mobile Phones.
Extra Resources (indicate if it is proprietary)	GameChangers Initiative (gamify.org.uk) will support teachers' initiation to game design practices (onboarding)
Time & Duration	2 to 3 series of Workshops of a duration of 2 days
The Game	Know games remixed by teachers into learning plans The BEACONING Game Plot
The lesson plan	At least two lesson Plans: • The Basic algebraic skills • The one related to coding and robotics Plus any original plan/Refinement of existing lesson Plans by teachers involved.
Evaluation Tool	

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	Participant Observation Focus Groups Survey
National Coordinator	Sylvester Arnab
Inclusion	Discussion and experimentation with accessibility features

3.4.3 HWU example in the UK

Goals	Organized in three parts, the aim is during a set of workshops for Teachers to : - Introduce the BEACONING concepts and learning Paths; - To create/refine the learning paths and practice them as if they were Students; - Collect Feedback; - Use the learning paths with students and visualise the results (evaluation).
Target	FE colleges: Edinburgh
Expected Number of Teachers	3 Teachers
Expected Number of Students	10 Students
Context	▪ Utilizing digital content, services and platforms to improve inquiry/problem-based VET-STEM education; ▪ Enhancing engagement in VET education to develop trade skills; ▪ Teachers Practicing with the BEACONING tools by: - Creating a set of learning paths; - Entering them in the Authoring tool; - Collecting feedback related to the Authoring Part; - Running the learning paths as if they ware students; - Collecting feedback related to the Student Part and the DashBoard part; - Refining their learning paths; - Running the learning paths with real students; - Collecting final feedbacks from students and teachers.

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Technical Setup	A dedicated BEACONING Lab composed of: - A Classroom with a set of computers accessing the BEACONING platform from the Internet; - A set of Beacons to be implemented in the workshop (optional).
Extra Resources (indicate if it is proprietary)	
Time & Duration	2 to 3 series of Workshops of a duration of 2 days
The Game	The BEACONING VET Game for stone masonry
The lesson plan	Quantification of resources, trade skills, VE-STEM • Resource selection and management appropriate for the methods of stone masonry work; • Organisational procedures and compliance to minimise the risk of damage to the work and surrounding area; • Contractual compliance with the given information to carry out the work efficiently to the required specification.
Evaluation Tool	EVALUATION FRAMEWORK FEEDBACK COLLECTION tool
National Coordinator	Lim Theodore
Inclusion	Discussion and experimentation with accessibility features.

3.4.4 Biba example in Germany

Goals	Organized in three parts, the aim is during a set of workshops for Teachers and assistants to: - Introduce the Beaconing concepts and learning Paths; - Collect Feedbacks; - Use the learning paths with students and visualise the results (evaluation) (2 units- one focussing more on how to use the geolocation based components, one more on learning paths); - Analyse the integration of beaconing components in existing courses;

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	- Get familiar with authoring tool and beaconing components.
Target	Uni. Bremen and BIBA-
Expected Number of Teachers	3-5 Teachers and 5 assistants (involved in teaching, but not formally course responsible)
Expected Number of Students	18-36 Students
Context	4. utilizing services and platforms to improve inquiry/problem-based engineering education. 5. enhancing engagement in science education among the young population. 6. teachers: Creating a set of learning paths; Use the learning paths in courses; Refining the learning paths; Try out the authoring tool and make changes in the learning paths; Analyse how different beaconing components (games etc) can be purposeful integrated in our classes. 7. Teacher assistants (technicians) practicing with the Beaconing tools by: - Entering them in the Authoring tool; - Collecting feedbacks related to the Authoring Part; - Running the learning paths as if they ware students; - Collecting feedbacks related to the Student Part and the DashBoard part; 8. Collecting final feedbacks from students, assistant and teachers.
Technical Setup	We will have two set – ups. One will just use the existing infrastructure in BIBA gaming lab, a second will only be set-up by usage since it will use the whole building (for testing geo-location based and the beacons in a learning context). Within the labs we will have computer/tablet access, devices for the students.
Extra Resources (indicate if it is proprietary)	The BEACONING lessons path will be an integrated part of courses given to students at the university of Bremen as well as an integrated part of workshops we offer to pupils from secondary school. The courses and the workshops already contain the usage of some other games. We will use the BEACONING lessons path methodology for both in order to ensure that

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	The workshop for pupils will also be applied at KTH but first after successful tests in Bremen (so probably 2018, BIBA autumn 2017)
Time & Duration	2 series of Workshops of a duration of 2 days with 2 weeks in between
The Game	The BEACONING Learning Paths Games and perhaps some others
The lesson plan	At least three lesson Plans: - One on engineering and logistics subjects (technology and engineering); - One on basic IoT (science and engineering); - The one related to coding and robotics. Plus the creation/Refinement of existing lesson Plans by the authoring team.
Evaluation Tool	EVALUATION FRAMEWORK FEEDBACK COLLECTION tool
National Coordinator	Jannicke Baalsrud Hauge
Inclusion	Discussion and experimentation with accessibility features

3.4.5 UCM example in Spain

Goals	The main goals of the pilot are to: - Introduce the analytics and visualizations to teachers in a real environment; - Refine the analytics system; - Collect feedback from teachers and students; - Collect data from students' learning paths and visualise the results (evaluation).
Target	La Inmaculada-Escolapias School in Madrid
Number of Teachers	3 Teachers
Number of Students	232 Students
Context	9. After receiving a brief presentation about the game, students, in order:

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	1. Completed a pre-test about specific game knowledge and game habits; 2. Played a serious game without any external help; 3. Completed a post-test about specific game knowledge and opinion about the game; optional additional comments were also available to obtain more feedback about the pilot. 10. While students were playing, teachers obtained near real time information with the analytics system, as visualizations and dashboards. 11. Teachers answered a few questions about the usefulness of the analytics system to keep control of the class.
Technical Setup	The pilot required: - A classroom with a set of computers accessing the serious game, previously installed on the computers; - An additional computer with internet connection for teachers to visualize the near real-time analytics.
Extra Resources (indicate if it is proprietary)	
Time & Duration	16 sessions during 5 days, with an additional recall session
The Game	First Aid Game
The lesson plan	The game aims to show first aid manoeuvres for three situations: - Chest pain; - Chocking; - Unconsciousness.
Evaluation Tool	Feedback was collected: - In the written post-test for students; - In a brief questionnaire for teachers.
National Coordinator	Balthazar Fernandez Manjon
Inclusion	Discussion and experimentation with accessibility features

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3.4.6 Sebit example in Turkey

Goals	The aims are: - To introduce BEACONING project; - To observe the relationship between a game and learning in game-based environments; - To observe the factors that effects learning in game-based environments; - To find out what properties should the learning scenarios for game base learning include; - To find out the responsibility of the teacher in a game based learning and define teachers training requirements; - To observe the difference between collaborative gaming vs multiplayer gaming; - To try "evidence centered design" for pedagogical evaluation; - Collecting feedbacks.
Target	Middle school 6th Grade Students (Age 11-12)
Expected Number of Teachers	1 Teacher
Expected Number of Students	12 Students
Context	12. Game based learning environment; 13. Designing a construction plan; 14. Enhancing engagement and transfer in mathematics education among sixth grade students; 15. Applying Design Thinking and Critical Thinking with Math Skills.
Technical Setup	Minecraft Computer Class at Maya School - 12 student computers; - 1 teacher computer; - Minecraft Education Edition; - Internet.
Extra Resources (indicate if it is proprietary)	Activity sheet (see Annex 4) Evidence sheet (see Annex 5)
Time & Duration	3 hours
The Game	Designing a pool for Taylor Swift's home, building at Minecraft and then updating using fractions.

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The lesson plan	The lesson plan: - Introduction to “learning as a game” concept; - Students will design the construction plan of the house+garden by using paper&pencil; - Students will design the house at Minecraft Education Edition; - Students will update their plan after upcoming change request; - Students will update their design at Minecraft; - Students will present their designs.
Evaluation Tool	Students will be evaluated with an evidence form. (see Annex 5)
National Coordinator	Sezin Alkabir
Inclusion	- None

3.4.7 Siveco example in Romania

Goals	- Introduce the BEACONING concepts and learning Paths; - To create/refine the learning paths and practice them as if they were Students; - Collect Feedbacks; - Use the learning paths with students and visualise the results (evaluation).
Target (when possible name the school or the entity)	14 schools
Expected Number of Teachers	14
Expected Number of Students	28
demographic of students to be engaged	At least 4 with special needs
Context (this should be a win-win situation for both the partner and the school)	1. utilizing digital content, services and platforms to improve inquiry/problem-based STEM education; 2. enhancing engagement in science education among the young population; 3. integration of mobile computing into existing practices.
Technical Setup	Own BEACONING platform (Romanian)
Extra Resources (indicate if it is proprietary)	N/A

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Time & Duration	2 series of Workshops of a total duration of 2 days
The Game	DRAG IT, MATCH IT, MILLIONAIRE QUIZ
The PlayLesson Plan	Energy Production Effects; Math for hearing impaired students
Evaluation Tool	Evaluation Framework Questionnaire for teachers and students
National Coordinator	Marius Preda
Inclusion	At least 4 students with special needs

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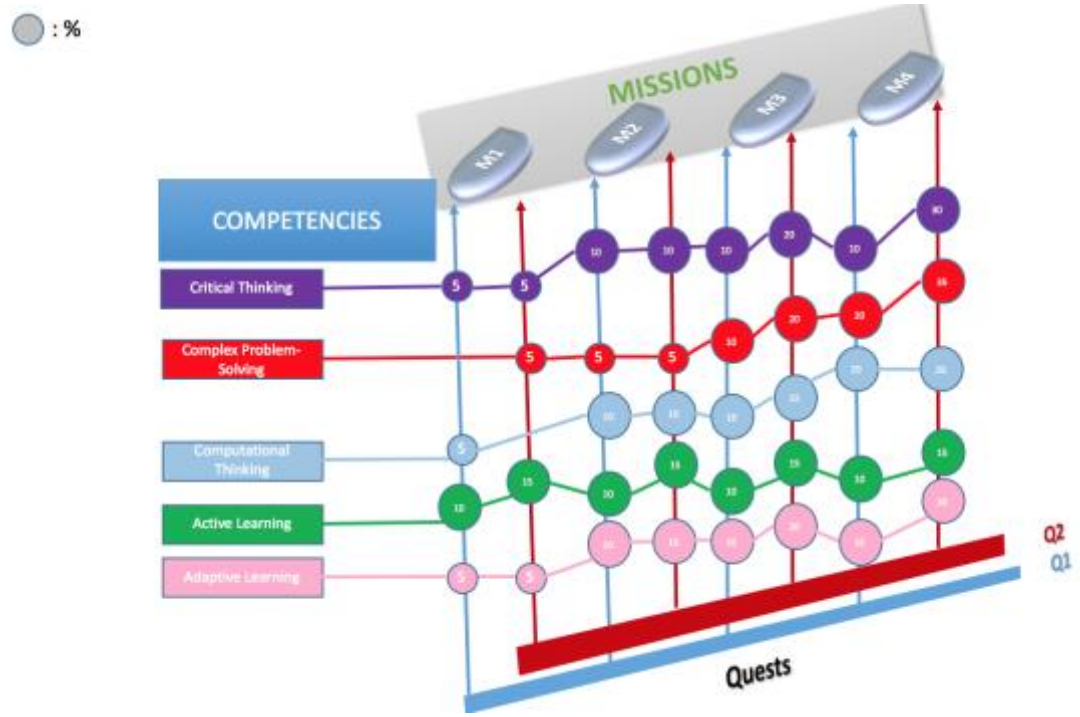
4 PILOT MEASUREMENT FRAMEWORK

4.1 MEASURABLE INDICATORS

4.1.1 Analysis of individual learning in depth

The small-scale pilot will first test the authoring part and the mini-games: we will combine to each scenario competences, which will be then combined to percentage, as the diagram below shows.



A percentage of accomplishment is defined in each Lesson Path entered in the authoring tools through learning objectives.

4.1.2 Specification of individual learning gain

The 2016 Horizon Report describes *learning analytics* as "an educational application of web analytics aimed at learner profiling, a process of gathering and analysing details of individual student interactions in online learning activities."

It is proven that the tailored-education improves visual tracking skills, hand–eye coordination, planning, concentration, memory and patience.

The learning analytics system comprises the data store, services and reporting system which, respectively, stores the data collected from students, interprets it into meaningful information and provides dashboards for that data integrated into the main user interface for teachers and students.

For its correct integration in BEACONING, pilots need to deploy their own learning analytics server. This server needs to be configured and connected with the games so they can send the leaning analytics information (in xAPI format). Notice that any desired game-dependent analysis (e.g. competence) has to be clearly considered in both the learning design and the game design

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so the game can send the required information as xAPI traces. For its analysis, a model should be provided on how to evaluate the obtained information (e.g. how to know if a competence has been fully attained or the extension of the knowledge of a student).

The learning analytics information will be accessible either in-game or in an external server accessible in a webpage. It is possible to obtain the information, as visualizations and dashboards, at near real-time or off-line.

Complete details on the component inputs, outputs, structure, requirements and deployment can be found in deliverable D3.6 System architecture of WP3 Requirements, design and specifications. The following sections aim to summarize their essential information.

4.1 3 Inputs and outputs

The analytics system only accepts xAPI as input format. Traces from games need to be formatted in xAPI using the Serious Game application profile, a standardized vocabulary to describe game interactions13. The complete vocabulary for serious game xAPI traces expected by the Analytics components is available at the ADL website14. This profile is going to be extended for BEACONING to consider geolocalization information.

The analytics outputs include dashboards and alerts with the information of the analysed traces. Further details can be found in deliverable D4.6 Game Analytics and adaptation component design of WP4 Platform Development and Ecosystem Integration.

4.1 4 Software and hardware requirements

Analytics can be deployed as a set of linked Docker containers, so its only software dependency is docker and docker-compose itself.

Recommended software

- Ubuntu >= 14.04
- Docker >= 1.13 and Docker-compose >= 1.7.1

Recommended hardware

- >= 12 Gb free HDD space after installation
- >= 4 Gb RAM
- >= 2 CPU cores

Questionnaires (teachers and learners) will come from T5.5, completed by T6.3.

[13] Ángel Serrano-Laguna, Iván Martínez-Ortiz, Jason Haag, Damon Regan, Andy Johnson, Baltasar Fernández-Manjón, Applying standards to systematize learning analytics in serious games, Computer Standards & Interfaces, Volume 50, February 2017, Pages 116-123, ISSN 0920-5489, http://dx.doi.org/10.1016/j.csi.2016.09.014.

[14] http://xapi.e-ucm.es/vocab/seriousgames

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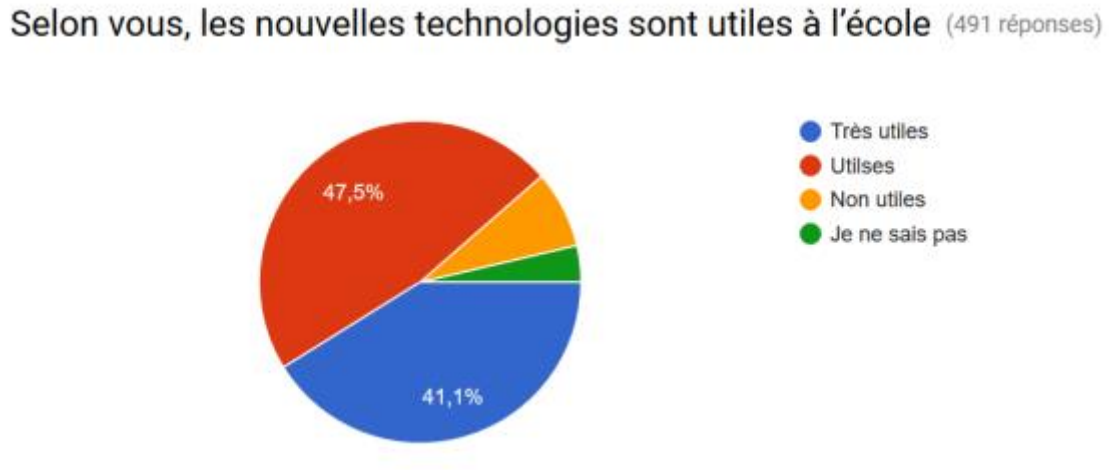
4.2 MEASURES

In September and October 2016, Ort France has conducted a large study among learners from 15 to 25 years old, about STEM and new technology. The results gave us reliable information on their opinions and feelings about their learnings

4.2.1 Level of acceptance

In order to learn properly, learners need to accept the methods that are used. The acceptance will lead to more motivation, therefore to success.

On our study below, on 491 learners 41,1% of them find that new technologies are very useful at school, 47,5% useful, 7,7% not useful and 3,7% didn't know.



But then, when we asked them "What added values do you see in playing learning games", out of 284 answers, only 110 indicated added values like concentration, motivation, learning while playing. It shows here that a majority of the learners are not yet convinced by the use of games as a learning platform. This last question will be asked after the small-scale pilot, to evaluate if their level of acceptance has improved.

This section is linked with point 5 on this document, where the Technology Advanced Model is described and developed.

4.2.2 Level of motivation

Our study shows clearly that one of learners 'biggest difficulty to learn is the lack of motivation. The diagram below indicates that to the question "What kind of difficulties do you meet in your daily learning (school, home…), 66,3% answered a lack of motivation.

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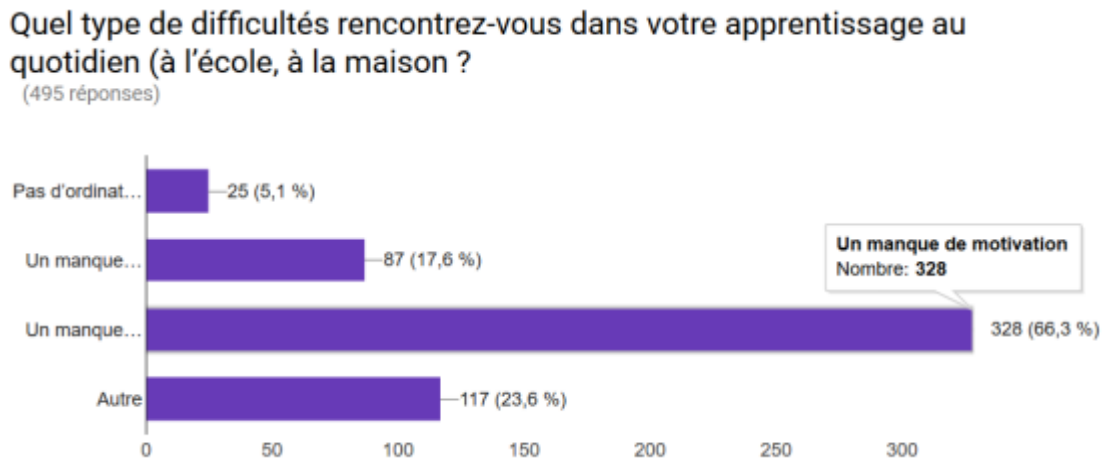

This lack of motivation is a real handicap that can explain a lot of failures at school. Motivation is a powerful energy that can lead to success and we will here analyse the degree of motivation the learners have after they have used the BEACONING platform and its minigames.

There are several reasons for this lack of motivation:

- They can do the assigned work;

- The "response" effort needed to complete the assigned work is too great;

- They fail to see an adequate pay off to doing the assigned work;

- Lack of confidence;

- They lack a positive relationship with the teachers.

4.2.3 Usefulness and accessibility

In order to evaluate the benefits of a digital tool, we have to evaluate if it is useful, easy to use and pleasant to use.

Usefulness is the quality of having utility and especially practical worth or applicability in the BEACONING platform

Does it allow students to learn better? Is it easy to use for 16-25 years old?

Is it acceptable? Is it compatible with time, space, and material, tasks with the classroom and with the values of the students in the class?

Our small scale pilot this task will focus on the design of activities that specifically target dyslexia and motor disabilities. It is therefore important to work on the accessibility of the BEACONING platform.

This section introduces some of the accessibility requirements for the BEACONING platform, minigames, applications, and other tools.

Accessibility standards:

The accessibility relies on several components that work together. Some of these include:

> The content - refers to any part of the platform, including text, images, forms, and multimedia, as well as any markup code, scripts, applications, and such.

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User agents - software that people use to access content, including desktop graphical browsers, voice browsers, mobile phone browsers, multimedia players, plug-ins, and some assistive technologies.

Authoring tools - software that people use to produce content, including code editors, document conversion tools, content management systems, blogs, database scripts, and other tools.

Standards play a key role in defining accessibility requirements for each of these components. Some accessibility requirements are easy to meet, yet understanding the basics of how people with disabilities use the platform helps implement them more effectively and efficiently. Some aspects of accessibility require more technical skills or advanced knowledge of how people use the platform. In all cases, involving users early in small scale pilot and throughout the project will make our work better and easier.

People who cannot hear audio or see video need alternatives. Examples of alternatives for audio and video include:

- Text transcripts and captions of audio content, such as recordings of people speaking
- Audio descriptions, which are narrations to describe important visual details in a video
- Sign language interpretation of audio content, including relevant auditory experiences

Well-written text transcripts containing the correct sequence of any auditory or visual information provide a basic level of accessibility and facilitate the production of captions and audio descriptions.

The authoring tool must also ensure that the user can navigate a document efficiently while editing, regardless of disability. Users who use screen readers, refreshable braille displays, or screen magnifiers can make limited use (if at all) of graphical artifacts that communicate the structure of the document and act as signposts when traversing it. Users who cannot use a mouse (e.g. people with physical disabilities or visual impairments) must use the slow and tiring process of moving one step at a time through the document to access the desired content, unless more efficient navigation methods are available.

Some users need more time than others to read and use the platform. For instance, some people need more time to type text, understand instructions, operate controls, or to otherwise complete tasks.

Examples of providing enough time include providing mechanisms to:

- Stop, extend, or adjust time limits, except where necessary
- Pause, stop, or hide moving, blinking, or scrolling content
- Re-authenticate when a session expires without losing data

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4.2.4 Learning outcomes

An outcomes-based approach requires a clear focus on continuous quality improvement. It specifies what students are expected to learn and arranges the curriculum such that these intended outcomes are achieved. It helps to provide clarity, integration and alignment within and between a sequence of courses, it promotes a learner-centred approach, it encourages a self-directed and autonomous approach to learning, as students can take responsibility for their studies, and are able to actively gauge their progress.

The statement are the focus in this chapter on the learner learning (what will the learner learn today), rather than instructor teaching (what am I going to teach today?)
We will therefore express learning outcomes for this small scale pilot projects in the way that reflects cognitive skills:
According to Bloom's Taxonomy[15], there are six levels (lowest to highest cognitive skills):

- Knowledge/remembering
- Comprehension/ understanding
- Application/ applying
- Analysis/ analysing
- Evaluation/evaluating
- Synthesis/ creating

We will use those learning outcomes to assess student learning through worksheets or one-minute papers where students demonstrate that they have met the learning outcome.

[15] Anderson, L. W., Krathwohl, D. R., Airasian, P., Cruikshank, K., Mayer, R., Pintrich, P., ... & Wittrock, M. (2001). A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy. *New York. Longman Publishing. Artz, AF, & Armour-Thomas, E.(1992). Development of a cognitive-metacognitive framework for protocol analysis of mathematical problem solving in small groups. Cognition and Instruction*, *9*(2), 137-175.

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5 LESSONS LEARNT FROM THE SMALL SCALE PILOT

Using the TAM (Technology Acceptance Model) and (ISSM) Information Systems Success Model after the testing of the small scale pilot will determine the “behavioural intention” of pilot users to adopt and accept the technology that is being piloted.
The model suggests that, when users are presented with a new technology, various factors influence their decision about how and when they will use it, notably:

- Perceived Usefulness (PU) – defined by Fred Davis as "the degree to which someone believes that using a particular system would enhance his or her job performance".
- Perceived Ease-Of-Use (PEOU) – defined by Davis as "the degree to which a person believes that using a particular system would be free from effort".

Our action point is to analyse the key pilot implementation requirements that include contents, specific learners ‘need and lesson plans.

The teachers are giving or adapting their own scenarios to the platform and it is important therefore to analyse their satisfaction, in order to make the adequate adjustment for the large scale pilot.

The objectives are to test the components on an individual point of view (rf. to deliverable 5.1), and through the integrated system (rf to deliverable 5.2) and to describe the feedback of the instructors.

The analysis of the instructors was taken from the following table:

Table 1

1. How satisfied are you with the current user interface of the BEACONING Platform?	Score from 1 (very satisfied) to 5 (not satisfied at all)
2. What further functionalities would you like to have in the user interface?	Free-text description
3. What further functionalities would you like to have in the teacher dashboard?	Free-text description
4. What do you think of the current courses’ syllabus?	Score from 1 (very satisfied) to 5 (not satisfied at all)
5. What kind of course syllabus would you like to see, as far as your subject is concerned?	Free-text description

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6. How satisfied are you with the current Authoring System?	Score from 1 (very satisfied) to 5 (not satisfied at all)
7. What further functionalities would you like to see in the Authoring System?	Free-text description
8. What do you think of the existing mini-games?	Free-text description
9. What further functionalities would you like to see in the mini-games activities?	Free-text description
10. What do you think of the interactive game for students?	Score from 1 (very satisfied) to 5 (not satisfied at all)
11. What further functionalities would you like to have in the interactive game for students?	Free-text descriptions

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LIST OF ANNEXES

Annex 1

Questionnaire Learners

Dear learners,
We are working on an EU project that focuses on Science, Technology, Engineering and Mathematics and the needs of learners. For us it´s most important to highlight your perspective in this work.

It would be great if you could answer the following questions.

Thanks in advance! Your answers are very important to us!

Sincerely

The BEACONING team

Are you: Female Male Would not define me

1**. What is a good learning environment for you that helps you and motivated you to learn?**

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box.]

2. **Are you interested in Science, Technology, Engineering and Mathematics?**

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Yes ☐ No ☐

3. **How motivated would you be to work Science, Technology, Engineering and Mathematics through a digital learning platform and mini-games?**

Strongly Not at all

1	2	3	4	5

4. What are your expectations in such a learning platform? How this can help you learn better?

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box.]

Annex 2

Questionnaire Learners with disabilities and dyslexia

Dear learners,
We are working on an EU project that focuses on Science, Technology, Engineering and Mathematics and the needs of learners with dyslexia problems and motor disabilities. For us it´s most important to highlight your perspective in this work.

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It would be great if you could answer the following questions.

Thanks in advance! Your answers are very important to us!

Sincerely

The BEACONING team

Are you: Female Male Would not define me

Your disability: dyslexia Motor disability other

1**. What is a good learning environment for you that helps you to learn despite your disability?**

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box.]

2. **What are the flows in your education system that prevent/ed you from learning because of your disability?**

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box.]

3. **How motivated would you be to work Science, Technology, Engineering and Mathematics through a digital learning platform and mini-games?**

Strongly Not at all

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1	2	3	4	5

4. What are your expectations in such a learning platform? How this can help you learn better?

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box.]

Annex 3

1. To what extent do you agree with the following statements?

To a large extant To a moderate extent To a small extent To a very small extent Not at all I do not know

It is essential to take initiatives that encourage digital learning

It is essential to work towards promoting digital learning towards dyslexia and motor disabilities.

My institution understands the importance of digital learning that can cover a wide public

My institution recognizes the value of a digital learning platform and encourages their teachers to use it.

2. What best describes your level of technology expertise in the classroom?

I'm very uncomfortable using technology in my classroom ◯

I'm fairly uncomfortable using technology in my classroom◯

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I'm fairly comfortable using technology in my classroom ◯

I'm very comfortable using technology in my classroom ◯

3. In your country, what options are available (formal and informal) for the lifelong training of teachers on digital learning among learners?

Formal courses / workshops ◯

Conferences ◯

Graduate education programs ◯

Self-paced distance learning courses ◯

Online communities / networks ◯

Individual or collaborative research ◯

Mentoring ◯

4. Have you participated in any of the activities mentioned before (point 3)

- YES◯ (please specify) _____
- NO ◯

5. I use ICTs in the classroom

mainly for administrative tasks ◯

mainly as a learning tool ◯

mainly for information / material ◯

for all the aforementioned reasons ◯

6. What ICT infrastructure is available in your school?

Personal computers ◯

Tablets ◯

Mobile devices ◯

Interactive boards ◯

Video conferencing systems ◯

Audio equipment ◯

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Digital photo and video cameras ◯

Educational applications ◯

Other ◯ (please specify)

_____

7. Do you have typical practices for digital learning in your country based on formal curricula?

- NO ◯
- YES◯ (please specify)

_____

_____

_____

8. Do you have typical practices for digital learning in your institution based on formal curricula?

- NO ◯
- YES◯ (please specify)

_____

_____

_____

9. Which of the following act as barriers in the process of using digital learning in your teaching [You can select more than 1 answer or/and add your comment]

- My limited availability
- My lack of skills in this domain
- institutional atmosphere
- My lack of interest
- lack of available means to use them
- I do not know
- other……

10. 'Mini-games in digital learning': Are you aware of this term?

- I have never heard about it
- I only know the term
- I have heard few things about it
- I am very knowledgeable about it

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- I am aware about it and I am interested in being trained to use it
- I am aware about it and I already employ practices in my class

11. How serious do you consider the use of mini-games and digital learning in your class?

- Not at all
- very little
- a little
- quite a lot
- a very great deal
- I do not know

12. Which of the following can be potentially achieved through the deployment of digital learning in your classroom? (You may choose more than one)

Knowledge building on specific subjects ◯
Customized learning ◯
Easier follow-up on each student ◯
Applying in practice theoretical skills ◯
Experimentation (e.g. simulations) ◯
Analytical skills ◯
Creativity ◯
Decision making ◯
Digital skills ◯
Problem solving skills ◯
Collaborative skills ◯
Self-awareness ◯
Learning for any public (including students with dyslexia,
Motor disabilities…) ◯
More motivation from the students ◯

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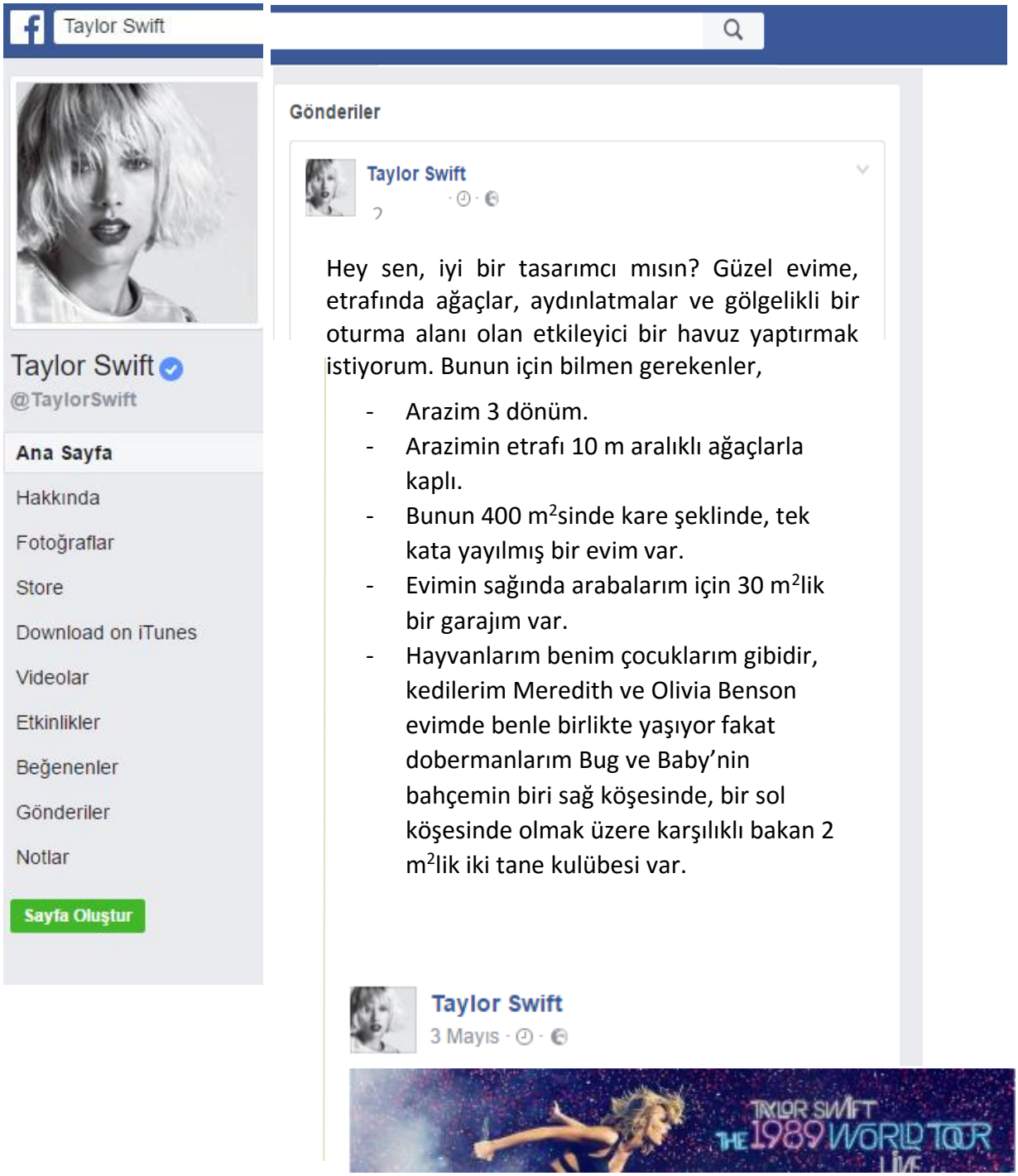
Annex 4

Taylor Swift, havuz partilerini yakın arkadaşı Selena Gomez'in evinde vermekten sıkılmış, kendi evinin bahçesine de etkileyici bir havuz yaptırmaya karar vermiştir. Bu havuz için farklı tasarımcılardan fikir beklemektedir, bunun için facebookta şöyle bir ilan paylaşmıştır:



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Annex 5

Kanıt	**Öğrenci 1**	**Öğrenci 2**	**Öğrenci 3**	**Öğrenci 4**	**Öğrenci 5**
Arazinin boyutunu ilgili birime çevirebilme. (defining)					
Arazi etrafına ağaçları yerleştirebilme. (defining)					
Evin boyutlarını doğru bir şekilde belirtme. (defining)					
Garaj boyutlarını doğru bir şekilde belirtme. (defining)					
Havuzun boyutlarını belirleme. (defining)					

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Havuzun boyutlarını belirlemek için internetten arama. (defining)					
Havuzun derinliğini doğru ayarlama. (defining)					
Köpek kulübelerinin boyutlarını doğru bir şekilde belirtme. (defining)					
Kanıt	**Öğrenci 1**	**Öğrenci 2**	**Öğrenci 3**	**Öğrenci 4**	**Öğrenci 5**
Evi doğru konumlandırma. (Finding relationship) or (drawing conclusions)					
Garajı doğru konumlandırma. (Finding relationship) or (drawing conclusions)					

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Havuzu doğru konumlandırma. (Finding relationship) or (drawing conclusions)					
Ağaçları doğru konumlandırma. (Finding relationship) or (drawing conclusions)					
Köpek kulübelerini doğru konumlandırma. (Finding relationship)					
Proje planını uygun bir şekilde yapabilme. (drawing conclusions)					
Proje planını oyuna doğru şekilde geçirebilme. (Finding relationship)-					

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Kanıt	Öğrenci 1	Öğrenci 2	Öğrenci 3	Öğrenci 4	Öğrenci 5
Proje planında güncelleme yapabilme. (defining)					
Uygulamadan sonra yaptığı proje planında neleri, neden değiştirdiğini belirtme.					

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