D 4.6 General Report: The DIY Labs in Action

March 2016

Do It Yourself in Education: Expanding Digital Competence to Foster Student Agency And Collaborative Learning European Commission Educations Audio-visual and Culture Executive Agency -71400ALLPA4A3541A4AESAKA1MP

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Type of Report

Public / March, 2016

Introduction

From January 2015 to January 2016, within the ***WP04 "DIY Labs in Action at School and Higher Education"*** of the EU project DIYLAB in three European countries (Spain, Finland and the Czech Republic), teachers from primary and secondary schools with their pupils (aged 6-15 years) and university teachers with their students (aged at least 20 years) implemented DIYLab activities and projects. Altogether in these DIYLab activities 478 primary and secondary school pupils (aged 6-15) were engaged with 36 of their teachers, and 607 university students (aged more than 20 years) with their 29 teachers. Altogether pupils and students created 217 objects published on the HUB.

1 DIY labs in action at Primary and Secondary Schools

1.1 Organizational framework of DIYLab

The DIYLab was implemented in the following schools: Escola Virolai in Spain, Koskela - primary school and Linnanmaa - secondary school in Finland (Teacher Training school of the University of Oulu, Oulun Yliopisto) and ZŠ Korunovační – primary school in the Czech Republic. The fundamental difference between primary and secondary schools consists in a fact that at the primary school level there is a class teacher who teaches practically all subjects. Therefore, it was easier for primary school teachers to support and arrange the interdisciplinary approach to DIYLab activities. In the Czech school, in some cases, the primary school teachers collaborated together to widen the cross-curricular character of the DIYLab projects.

Primary and secondary school pupils involved:

- in Spain: 5th Grade (age 10-11 year), 3rd Grade (age 14-15 year)
- in Finland: 5th Grade (age 11-12), 7th Grade (age 13-14), 8th Grade (age 14-15 year)
- in the Czech Republic:1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, and 9th Grade (age 6-15 year)

Subjects developed:

- in Spain: Social and Natural Science, Catalan, Spanish, Mathematics, Technology, English
- in Finland: Crafts, Physics, Chemistry, Finnish, a second language, Mathematics, Home economics, Geography, Biology, History, English (cross-curricular projects)
- in the Czech Republic: Basics of humanities and natural science, national history and geography, Mathematics, Czech language, English, Computing, Natural Science, History, Civics, Physical education, Art Education, Practical and technological activities

Location where pupils accomplished their DIY activities:

- in Spain: in different spaces within the school, at home
- in Finland: in school, different physical locations
- in the Czech Republic: in school, out of school (in the park etc.), at home

The final products for DIYLab HUB were mostly by a pair, or were team products. Sometimes it was individual work (for example in Finland school seventeen 8th grade pupils did an e-book as a single person's outcomes). In the Czech school, some outcomes were developed collaboratively by all of the pupils in one class.

Tab. 1 DIYLab activities in primary and secondary schools described by numbers

Primary and secondary school	No. of Pupils	No. of Teachers	No. of Subjects	No. of Activities	No. of Digital Objects published on the HUB
Spain	95	15	9	2	32
Finland	114	14	18	9	56
Czech Republic	269	7	13	20	20
Total	**478**	**36**	**40**	**31**	**108**

1.2 DIYLab Activities

1.2.1 Fundamental description and characteristics

In Spain, the DIY philosophy was implemented within two DIYLab activities: "**Creation of Smartphones applications"** at primary education, and the "**Technological Project Internet of Things"** at secondary school level. The primary school pupils "have had to create new smartphones applications, adding a new functionality to the existing ones. Having once devised the applications, students designed the interface and menus. Finally, students prepared a presentation explaining the newly created applications, and the new or alternative features added to the existing ones. Furthermore, they showed the steps followed during their creation, and finally, what the social benefits of the application were. Secondary school pupils participated in "Technological Project about the Internet of Things", based on the study of the city and its needs, designing a technological device to help improve citizens' lives. The solutions had to use a system of interaction with the environment (sensors) in order to capture information that must be processed. Furthermore, the system had to make decisions and operate according to the environment, and/or to publish the status of the sensor on the Internet. The device in question had to be able to work autonomously, without human action."

In Finland, the DIY philosophy was implemented within five main activities: "**Force"** at primary education and at secondary education through "**Traffic behaviour, road**

safety, environment", "**Light**", "**Europe yesterday and today**", and "**North-America and immigration throughout history**".

In the Czech Republic, ZŠ Korunovační implemented DIYLab activities as a school project, interconnecting primary and secondary level education across the whole school; there were only 4 teachers and 3 classes that did not participate in the DIYLab activities, being involved in other projects. There were 80% pupils, and 80% teachers from ZŠ Korunovační involved in the DIYLab activities.

Apart from the six fundamental pedagogical principles for DIYLab activities ZŠ Korunovační sets its own internal parameters which, to be more precise, correspond to the teaching approaches applied at ZŠ Korunovační and, at the same time, they enrich the DIY philosophy of the school. The school placed great importance on the quality. The school also gave great attention to what the children created in the DIYLab, as something useful, beneficial, interesting for other pupils. For example, a group of pupils organised an exhibition for pupils from other classrooms; another group of pupils who played the role of guides developed information study materials (i.e. a handbook) for other pupils who could use these materials during an outing through a parkland close to their school. Another group of pupils produced teaching aids for a Mathematics lesson, to enable them to use these aids, and to tutor their schoolmates - the teaching aids authors played a role of tutors to their schoolmates. Most of DIYLab activities were implemented as an extension, and a high quality was expected. The accent was put on the process of learning, positive experiences, the development of multiple competences, a positive climate in school, together with playful teaching methods.

1.2.2 The main objectives of DIYLab activities

All schools involved in the DIYLab projects strove to achieve DIYLab activities that would fulfil six fundamental characteristics (see WP1 and WP2): collaborative learning, digital literacy development, a cross-curricular approach, a suitable curricular context, autonomous learning, and inquiry based learning. Nevertheless, in addition to these six parameters, each of these schools also implemented into their DIYLab activities its own specific educational approaches.

In Spain

At the primary school education level, the school also fostered pupils' creativity, autonomous development, personal initiative, digital competence and management of learning among others.

At the secondary school education level, the school endeavoured to connect the educational task in the classroom with a real context, in order to support an interdisciplinary and transcendental approach, to motivate and promote an applied and meaningful learning experience for the students, and to involve them in the design of a model with a sustainable future, both environmentally and socially.

The majority of the DIYLab activities organised by the Spanish school strove to interconnect the school curriculum with current and relevant topics, or problems of citizens related to life in the city, and in the local region:

- A participatory city, committed and solitary, where innovation and technology are tools to ensure a better life for citizens.
- Raise awareness among the youth about the role that cities such as Barcelona, with an educational, global, solidary desire, can be seen as a reference for other cities in the world.
- Help students analyse the city in which they live.
- Promote responsible citizenship.

One of the most important priorities in DIYLab activities was to give students an opportunity to be creative, to be authentic and independent in their decision-making and thinking, and to do what the students like to do out of school which can give a chance to

- Help students acquire autonomy.
- Let students apply their creativity, their prior knowledge and skills.
- Create solutions that respect the environment.
- Foster creativity.
- Foster innovation.
- Bring the students' interests to the school setting.
- Create the right atmosphere for the development of ideas and creative outcomes.

In Finland

The main impact of the DIYLab activities on primary education level can be seen in their relation to the curriculum, digital competency improvement, and autonomous and collaborative learning. According to teachers' monitoring reports, the whole process at primary school was totally carried out by the groups themselves. At the secondary school level, all teachers saw DIYLab and its benefits more as transversal competence areas and future life skills, rather than being a part of the subject-oriented school structure. Teachers tended to guide and restrict pupils' work more than at primary school level; in some cases the pupils did not follow the teacher's instructions. In the teachers' opinion, the DIY activities contributed primarily to autonomous learning, and not so much to digital competency development.

In the Czech Republic

The DIYLab activities at ZS Korunovační were managed in accordance with the ideas of the mission and philosophy of creative schools, to which ZS Korunovacni belongs. The main focus of DIYLab activities, therefore, was focused on a) a production of artefacts for usage in practice, b) a new framework for the project days, and c) parents' engagement in activities, too.

1.3 Digital competence

In Spain

Pupils demonstrated their high knowledge regarding digital tools and applications, for instance, at the time of recording and editing of videos, and in the preparation of the presentations of their work. Digital literacy has been strengthened throughout the process, as digital technologies were always present in one way or another, integrated completely into the working rhythm, and the methodology.

- At primary level education, teachers suggested the main tools to be used in the project, which were related to the search for information on the Internet, learning to manage mail, and transferring data from Google Drive, from the virtual classroom of the school, or through a USB. Moreover, to make presentations, students used PowerPoint and Canvas Instructure. Some students used other applications autonomously, either because they already knew them, or just because a partner explained to them, for example graphic drawing for tablets, Flipagram, and Youtube. Students learned to handle photography and video cameras by the fact of introducing the documents in classroom. In this case, the DIYLab's implementation approach has fostered digital competence. Before the questions asked to primary school students, regarding the use of any particular digital resources for the development of the activity that they did not know before, the responses were PowerPoint, Drive, and Canvas.
- Teachers suggested the tools used to develop the project from secondary school, and those used to prepare the pupils' presentations. Google Apps for education were used as the main communication tool, with Google Sites used to host the main page of the project, Drive to share the documents, and Google Talk to chat) The videos were recorded using the students' own mobile phones and they were edited using Movie Maker. The presentations were prepared with MS PowerPoint, Prezi and Powtoon. To create the devices of IOT project (Internet of things), the platform of Raspberry Pi was used, together with a variety of electronic sensors (FC-28 Humidity Sensor, ultrasonic, infrared sensors, gas sensor MQ-2, LDR and LED). Pupils used the programming language Python to control the platform. The dweet.io platform was used to publish the results in real time on the Internet, and to monitor the system. Thus, pupils had competence with regard to the use of these tools, and those features that they did not know before, but they learned by tutorials from the Internet.

In Finland

When teachers planned their activities, they knew that the final results should be in a digital form for the DIYLab-hub, and this emphasized the use of ICT. New ICT equipment in use was GoPro camera in history projects, but mainly pupils used the schools' normal equipment and applications, such as PC / MS Office and iPad/ iMovie. The secondary school physics project on the speed of the light was carried out in cooperation with the university, so the measuring equipment and applications were special and pupils were highly motivated. Pupils' answers to questionnaires tell about the use of ICT, and that they liked to use computers and applications for their own work and production. At the same time,

they used familiar applications in a new and more creative way, compared with "single lesson and single subject" for more traditional assignments. As pupils and teachers are quite familiar with the school's technology, there were no big problems with it. Technological and human errors, a sluggish network, and complaints were anticipated, as these come with the territory. The good example of the use of ICT is the description from the primary school projects by the teacher: "Our class is used to using our MS Windows-based ICT-class, and they have iPad minis which they can bring to their lessons when needed. During this project, they used the internet and applications such as IMovie, Keynote, IStopmotion or iPad camera. Some lessons were dedicated to learning the IStopmotion animation application, but they didn't order anyone to use it. One group used it as their main application. The main thing was that the group decided which software was the best for their own particular use.

In the Czech Republic

The pupils and their teachers could use hardware (HW) and software (SW) available at their school, and also their own mobiles and tablets (BYOD). The school offered to pupils:

- a computer network with 25 PC, 5 IWB, 2 visualizers, 3 digital cameras, 2 tablets
- standard SW applications (MS Office, Photoshop elements, Irfan View, Zoner Calisto, Smart Notebook, CMap Tools, etc.)

The pupils in DIYLab used only some HW and SW: a relatively narrow spectrum of SW and HW. Their activities with digital technology at school were limited by the technical equipment of the school. The pupils gained new specific competencies through some DIYLab activities, first of all the ability to apply particular SW, for example Movie Maker, and MS Excel. The aim of some activities was to introduce pupils to the usage of a digital tool which they have not used before. There was also a DIYLab activity through which the pupils familiarised themselves with professional facilities for animation and film editing, and thanks to which they could see a professional working with digital technology, and all together they made sequences for an actors' animated film.

In the course of DIYLab activities, there were some problems with using technology caused as a result of outdated technology, for example the insufficient capacity of memory for video production and sound processing, a small number of portable technologies, and only three digital cameras. For pupils, it was not a problem to work with digital technology: they like to work with technology, and they were motivated to learn how to use it. They spontaneously used their own devices, primarily mobiles connected to the Internet and AV media. The pupils had some problems in the final phase of DIYLab activity when they did outcomes - how to transmit data into a PC, to edit video, addition of sound, and dubbing of pictures. The pupils of Year 4 used PowerPoint without any problems. The pupils, at least of Year 6, developed conceptmaps in CMapTools without any problems, too.

1.4 Teaching methods and approaches

In Spain

At the primary school level, the approach to the activity was developed on the basis of a *discussion* in class, in which students raised a number of Apps known, regarding their implementation in real life, as well as, their limitations and gave solutions to the current

problems at the same time. After the *reflection* originated from this discussion, teachers proposed a *task*, which has *creativity* as the main purpose. Students are asked to use their imagination in order to *develop* mobile Apps with the intention of making an easier and more entertaining life within today's society.

During the activity the students followed these steps of work (Tab. 2).

Tab. 2 Steps of work

A stroll through the history of media
Analysis and evaluation of media with the aim to choose an invention
Design a new App
Present the developed App
Visualize a process of learning

At the secondary school level, the impulse for the DIYLab activity was born out of the school by the City Council that gave students an opportunity to participate actively in a design of the city in which they live. It was a great challenge for students to decide *completely autonomously* on the subject they wanted to investigate, the solution they wanted to create, and the device or technological application they wanted to develop. The DIYLab activity was carried out step by step through 23 sessions of teaching about natural science (3 sessions), social science (8 sessions) and technology (10 sessions) and 4 sessions of globalizing activities; there were used a combination of various teaching approaches: problem solving; brainstorming; discussion; development of a learning activity for 2nd grade students; transformation of halls, landings and rooftops of apartment buildings in areas of co-existence areas; furniture design; project work to provide a technological solution to the problems of a modern city based; creative work with using the platform Raspberry Pi and the Python programming language; project development with solutions of Internet of Things; performing video scripts, and presentations with meta-reflection on the learning process.

In Finland

Since the schools have good facilities DIYLab activities did not need any special arrangements. The most important organizational aspects at both schools were support from the rector and administration, which enabled a more flexible timetable and co planning for the teachers. However, time and planning resources were often considered insufficient.

In the Czech Republic

There were no restrictions for teachers about how to design DIYLab activities: teachers could decide the topic, aspect, and timing of the activity. Together with their class, they prepared an activity respecting and accepting a management schedule, a target group to whom the outcomes are dedicated, aims and form of outcomes, and the necessary tools and

aids. They put the accent on a learning process, positive experiences, multiple competences development, engaging climate in school and playful teaching methods. The idea to support through DIYLab activities in which a group of pupils would teach another group of pupils to understand a problem/ topic proved to be very well-chosen.

1.5 Summary

The DIY activities in primary and secondary schools were organised for pupils aged 6 to 15 years, with the majority of students aged 14-15 years. Nevertheless, primary education pupils were very motivated and enjoyed solving the DIYlab problems. In some cases, some their results have not been entirely satisfactory, and the teachers had to guide their work more than with secondary school students. DIY activities were implemented into the majority of school subjects, and had a cross-subject character. DIYLab activities were successful both in school and out of school, including home preparation for school. The majority of final DIYLab artefacts in the HUB were realised as part of team-work. In all three countries students proved they are incredibly creative, they have a lot of original ideas, and they have to learned to follow through with their projects, and to communicate in a refined manner. The DIYLab activities demonstrated that students have no substantial problems to use technology which they have not used previously; the students are able to start to solve problems with unknown technology in projects which are attractive and meaningful for them.

A role of the primary school teachers in the DIYLab differ from a role of secondary school teachers. The primary school teachers were faced with a problem that for pupils it was not easy to learn through doing their own research, or to use digital technology for research in a particular topic. Another problem which primary school teachers faced was to go beyond what their pupils have already known. The secondary school teachers could take into account that their students are able to be more independent in their learning. The biggest problem these teachers were faced with was time (time for motivation, discussion, brainstorming, doing a review) and sometimes teamwork (social relations, to bring activities to a conclusion, concentration to the work).

2 DIY labs in action at universities

2.1 Organizational framework of DIYLab

There were three fundamental factors which influenced the implementation of the DIYLab activities at the university level of study:

- Organizational scheme (part-time/full-time study; seminars/lectures; timing: academic year divided into semesters and periods of exams, period of teaching practice in schools);
- Teaching approaches and methods (students are adults);
- Focus of universities: University of Barcelona (UB) and Faculty of Education at Charles University (CUNI) are oriented on pedagogy, education and teacher education. Most of students from CUNI were ICT student teachers specialized on ICT in education.

The integration of DIYLab activities were spread out within particular semesters: summer semester 2014/15 and winter semester 2015/16. The deadline for a DIYLab pilot was postponed from December 31, 2015 to January 31, 2016. A pilot study with some students in the winter semester of 2014/15 was part of the implementation of DIYLab at the University of Barcelona, and also at the Faculty of Education (CUNI). This pilot allowed improvements in the ways of introducing DIY philosophy to students; the approach of the subjects in relation to the DIYLab project; and the understanding of the production of the digital objects process. Most of the student teachers of the Faculty of Education (CUNI) were introduced into DIYLab philosophy in some courses focused on pedagogy, didactics of ICT education, computing education etc.

At UB, the DIYLab activities were accomplished at the Faculty of Education and at the Faculty of Fine Arts. At CUNI, the DIYLab activities were implemented primarily in courses managed by the staff of the Dept. of IT and Technical Education (KITTV) in collaboration with colleagues from the Dept. of Art Education (KVV) and Dept. of Biology and Environmental Studies (KBiES).

The following table (Tab. 3) summarizes the number of all stakeholders and educational contexts that were activated throughout the implementation period.

Tab. 3 Summary of stakeholders and educational contexts

Uni.	Faculty of	Field of study	No. of students	No. of teachers	No. of courses or activities	No. of Digital objects
UB (Spain)	Education	Pedagogy	228	11	5	51
		Social Education	79	4	3	3
		Early Childhood and Primary Education	12	2	1	4
	Fine Arts	Fine Arts	152	3	2	18
CUNI (Czech Rep.)	Education	ICT Education	196	6	13	24
		Biology Education	23	1	3	3
		Fine Arts	23	1	1	6
Total		**7**	**713**	**28**	**28**	**109**[1]

DIYLab was implemented in the following subjects related to study fields:

- **UB, Pedagogy**
  - *1st Year:* Communication in Education
  - *2nd Year:* Teaching and Learning in the Digital Society, Digital and visual culture in the socio-educational processes
  - *4th Year:* Technological Learning Environments, Processes and Resources
- **UB, Social Education**
  - *1st Year:* Uses, possibilities and limits of information and communication technologies
  - *2nd Year:* Didactic foundations of the socio-educational action
  - *3rd Year:* Internship
- **UB, Early Childhood and Primary Education**
  - *4th Year*: Virtual Learning Environments
- **UB, Fine Arts**
  - *2nd Year*: Psychology of Art and Gender Studies
  - *3rd Year*: Contemporary Visualities

[1] Not all objects have been published on DIYLabHub - depending on a quality and the criteria set by the project.

- **CUNI, ICT Education**[2]
  - *Bc 2nd Year*: Web Design for Education, Object Oriented Application Development
  - *Bc 3rd Year*: Educational Robotics, Building and Designing Multimedia Applications, Authoring Systems and environments
  - *M 1st Year*: Designing of Didactics Materials, Didactics of ICT 01 and 02, Instructional Technology
  - *M 2nd Year*: Didactics of ICT 03 and 04, E-learning in Education, ICT Competence of Teachers
- **CUNI, Biology**
  - *Bc 1st Year*: Systematic and Evolutionary Botany, Plant Anatomy and Morphology, Collecting and Processing of Biological Material
- **CUNI, Fine Arts**
  - *M 4th Year*: Art Education for Primary School

Just to explain, the number of students involved in the DIYLab activities cannot be perceived as a total number of students: it should be read as a sum of all students participating in particular activities. Sometimes (especially in ICT Education courses at CUNI) some university students participated in more than one DIYLab activity in various courses (in summer semester 2014/15 and, later, in the winter semester 2015/16). In some cases, at UB, teachers invited some PhD. students to help and support participants involved in DIYLab. Figures of produced objects (or incomplete objects) differ from case to case.

Sometimes the students were working individually, and the number of digital objects may even match the number of the students included. At other times, the students were working in groups, so the number of digital objects may be lower. The UB used bigger groups to solve a task than CUNI, as we can see from the table above.

There were, within some activities, more than one object built by a group of students undertaking one task.

The organizational concept of each activity at CUNI was such that they were whole semester projects, or minor tasks during a semester. The activities at UB took place from one to four months, depending on the work required to build the digital objects.

The environment and conditions for DIYLab activities were closely connected to the facilities and possibilities of the institution, regarding subject field and procedural stages of a given DIYLab activity.

[2] Bc. - Bachelor Degree programme, M - Master Degree programme

There were two categories of working space in which DIYLab activities were carried out:

1. Environment for self-regulated work of students beyond seminars, courses, out of the faculty (student college dormitory, home, museum, exhibitions, on-line systems, schools, metro, trams, streets, etc.)
2. Environment for common collaboration and work of teachers with their students (Computer Labs, Lecture rooms, Ordinary classrooms, Biology laboratory, Teachers offices, Virtual Campus, Atelier, etc.)

At UB, some special places were used for the DIYLab activities, "*Barcelona's cultural spaces such as the Centre for Contemporary Culture of Barcelona (CCCB) and the Centre of Art Santa Monica, where visits were made to exhibitions related to the courses content.*"

In terms of organization, the realization of DIYLab was very similar at both CUNI and UB.

2.2 DIYLab Activities

During the DIYLab implementation process at both universities, CUNI and UB, the activities were regularly monitored. Data made available during the seminar visits were discussed on regular meetings with all the teachers who participated in the DIYLab project. Besides that, a lot of data about the implementation of DIYLab were gained through questionnaire surveys organised with students and teachers[3] when the DIYLab activities were over.

2.2.1 Design of Activities

In general, the UB carried out the proposed activities in relation to DIYLab in line with the subjects' content, although in some cases, the development of the DIY digital object proposed was not totally integrated, and students chose to take a different direction in terms of their learning, as happened in one of the subjects involved.

In the implementation of DIYLab in the courses of the University of Barcelona, four different strategies were identified:

Strategy 1

This dynamic created a space where the students could feel immersed in the course content, and thus arrive at their class prepared with specific questions and thoughts, so that everyone in the classroom could be able to discuss different matters. The implementation DIYLab could be understood as a "flipped classroom".

- On the first day of class, the teachers asked students to seek information on the DIY philosophy, the project DIYLab, and to think about its relationship with the subject.
- After collecting this information at the next session, teachers presented the DIYLab project to students with the support of the website and "official" presentation document. They referred to the DIY philosophy, the DIYLab project and the teaching and learning methods to be used. We informed students that by the end of the course they must submit a digital object with some defined characteristics.

[3] See Annex A and Annex B.

Strategy 2

This course was designed to accommodate developing content and meaning, while it was being implemented, so that, although it is based on a defined programme, this could be modified to match the idiosyncrasies and particular learning needs of the group. The subject was expected to be broken down into different blocks that would be interspersed among them. The implementation of DIYLab was carried out throughout the course, setting the goals and directions of the project and its implementation, dedicating intermingled sessions to introduce the DIYLab project, talk about the DIY philosophy, to bring in the DIYLabHub, and to explain the characteristics of the digital objects to be developed by the end of the process.

Strategy 3

Having passed several course sessions, the teacher proposed an intermediate activity: Students had to prepare, individually, a DIY outline containing the main elements: authors, images, quotes, ideas, concepts, to inform their learning through the course.

The next step was to explain what they had learned, how, and why. All of this in the face of the final course' assignment, consisting of a detailed plan, a visual narrative or an essay that students could optionally convert into a digital DIY object.

Students had three weeks from the moment the teacher gave them the assignment to its delivery. During this time, students had 15 minutes per class i.e. two per week, and personal tutorials to solve problems.

Strategy 4

The project was introduced at the beginning of the course, students were encouraged to develop a summary of their learning processes, and had about a month to carry out this task independently outside the classroom. In an initial session, the class shared the potential tools for the creation of multimodal stories and students started developing scripts with the support of the teachers. After this month, the teachers had a further month to watch and evaluate the production, and then a session dedicated to sharing their detailed conclusions.

The general atmosphere in the classes was favourable to the development of the proposed activities related to DIYLab, as the students perceived them as contrary to what they are normally asked for. The classes became more participatory and dynamic than usual, since the teacher did not control the information, but everyone was, to a greater or lesser extent, able to discuss the issues at hand.

At CUNI, students chose their DIYLab activities themselves, or co-operated in designing them in some subjects. In others they picked from a list. There were two conceptual frameworks for the DIYLab implementation, depending on its integration into a type of study

- In Bachelor level studies, the activities mostly focused on the development of expertise and competence in relationship with the subject content. Often it involved a processing of the contents of subjects into the output of the DIY object, and the reflection of such processing. However, students were not always able either to

transcribe or describe the process. The activities were focused on the resultant product, the DIY digital object (Building android apps, multimedia project, development of an educational digital object, systematic botany, plant anatomy and morphology, biological and geological technique in schools).

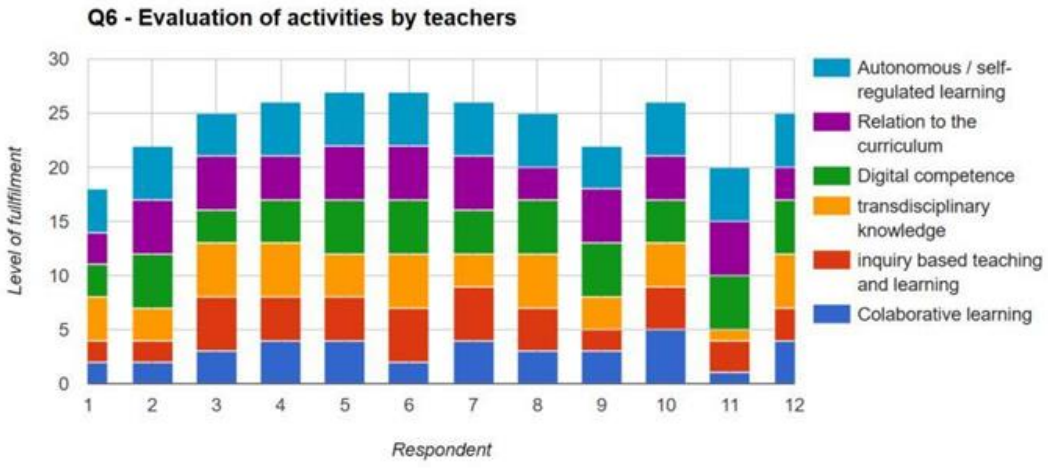
- At Master's degree level studies, which is much more focused on educational problems and points of view, these activities were more focused on the process and the methodical procedure of processing certain problems (How I'm becoming a teacher, educational robotics project, Wiki of educational activities, how to create a digital educational manual for work with an interactive board). In some educational subjects, the DIYLab activities became parts of topics related to teaching methods and learning assessment in ICT/Computing courses at curriculum for Primary or Secondary School Education.

All the DIYLab activities at CUNI were based on fundamental concepts established within WP2. However, the strategies for the activity suggestions were individual to each teacher or subject, respectively.

2.2.2 Achievement of the main values attributed to the DIY philosophy

Most of the students involved at the UB, whether or not they knew the DIY philosophy, positively evaluated, it according themselves, by its bond with the punk, anti-consumerist and self-generated movements (McKay, 1998; Kamenetz, 2010). At CUNI, similar feedback from students was given.

The following graph shows the results of the teachers connecting the six basic pedagogical principles to the activities at CUNI. The scale of accomplishment of each of the six principles (collaborative learning, transdisciplinary knowledge, relation to the curriculum, digital competence, inquiry based learning and teaching, autonomous / self-regulated teaching) is from zero to five, zero being no accomplishment and five being maximal accomplishment.



Average values for each item (Q6) from the evaluation of activities by teachers at CUNI are shown in the following list:

- autonomous / self-regulated leading 4,8
- digital competence 4,4
- relation to the curriculum 4,3
- transdisciplinary knowledge 3,9
- inquiry based teaching and learning 3,6
- collaborative learning 3,1

Collaborative work

The collaborative approach was the most irregular one, depending on each particular process. This fact could be applied for both CUNI and UB, while different values on scales can be of various reasons:

- Developing most of the DIY digital objects outside the classroom, making it difficult to have evidence of the collaboration occurred between students, and intervening in the appeared problems, solved with the help of others, but not in the classroom. (UB)
- Students' difficulties when contributing to the conversations and discussions in the classroom and the Virtual Campus. (UB)
- When those who did not have a clear notion of what to do, or had rather poor ideas, there were difficulties in receiving and acknowledging the advice or suggestions from their classmates and teachers. (UB)
- Students' difficulty in understanding that collaboration and cooperation can take place in an individual activity. (UB)
- Irregular class attendance and thus irregular communication among students and teachers. (UB)
- Lack of collaboration between groups. (UB)
- Timetable clashes among students in the afternoon shift that has hampered for example, to meet outside the class to work. (UB)
- Students of combined studies live and work in different parts of the Czech Republic and only meet during classes at school. (CUNI)
- There are very few students in some student groups, especially concerning Master's degree full time studies. (CUNI)
- Some topics were extremely specialized, and the tasks had to be solved individually. (CUNI)

At CUNI, some DIYLab activities were organised and solved in on-line collaboration, especially in courses with part-time students; this on-line collaboration was also the intention of the activity. On-line collaboration was not always successful.

"Online cooperation is one of the new competences, which will be required not only for employees, but for learning and personal life. That is why we made the development of this skill so important and why we wanted to show it to the students, give them some space to think about it and even have them practice with others."

"Some students were unable to put online cooperation in use even after they had seen an extensive amount of videos on that very topic (videos of experienced teachers using ICT from all the corners of the Czech Republic)."

In some DIYLab activities, teachers cooperated with each other within one or more departments.

Inquiry-based teaching and learning

Most activities proposed at UB were focused on promoting students' capacity to pose new questions and challenges to be approached and solved by themselves, always with the support of teachers, complementing and facilitating the construction of dialogues to develop their research projects.

Activities and topics discussed by CUNI students were not routine tasks usually assigned in seminars. In some cases, the students faced technological problems (see *Building android apps* or the specific solution for *Installing a camera in a birdhouse* for the subject Multimedia systems), in other cases the activities were more theoretically focused.

Transdisciplinary Knowledge

All activities relating to the DIYLab project at UB have been implemented in formal university courses of different degrees; however, most of them have a transdisciplinary dimension. This dimension was extended by the role given to the analytical and critical skills, and the socio-political positioning.

Almost all of the activities at CUNI were parts of obligatory subjects at PedF UK. Most of them had transdisciplinary overlap. In some cases, the transdisciplinary cooperation became obvious only thanks to the cooperation for the DIYLab project, and had an impact in forming the professional competence of future teachers to be self-reflective, as was seen in the activity "How I'm becoming a teacher."

Moreover, students of UB had the opportunity to contribute with experiences and lessons, accumulated throughout their life, related to the different topics of the subjects such as digital identity and the use and influence of images throughout their lives and in their daily experience. Other intersections can be placed between digital technology, learning environments and educational processes; or between digital and visual culture and its implications for education.

In 14 cases (out of 49 surveys handed in at CUNI) the students stated that they did not use their knowledge from other subjects in their DIY activities. If there was any required knowledge from other subjects, it was mostly physics, mathematics, English, geography, medicine or cinematography. For the students not studying ICT, they also needed the skills and knowledge of information technology.

Digital literacy improvement

According to Eshet-Alkalai (2009, p. 93), "digital literacy involves more than the mere ability to use software or operate a digital device; it includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need in order to function effectively in digital environments". Improvement of digital literacy in the DIYLab activities was developed in the context of a holistic conceptual model for this concept that involves the following cognitive skills: *photo-visual digital thinking, reproduction digital thinking,*

branching digital thinking, information digital thinking, socio-emotional skills, very quick or almost instantaneous thinking.

All teachers involved paid special attention to the development of all these dimensions of digital literacy. The results have been obvious in the majority of the work done by students in their DIY objects. At CUNI, the development of digital competences was one of the main focuses. It mostly involved subjects or teachers from the Department of Information Technology (KITTV), and students, who will one day be teachers of ICT in primary and high schools. These students are extraordinarily devoted to their theoretical and practical studies in information technology.

In terms of photo-visual skills, the DIYLab's contribution was mostly in the form of audio-visual objects. Students learned the importance of information in images through creating their own outputs for several target groups (primary school pupils and their parents, fellow students etc.). During the DIYLab activities, it became obvious that the students of ICT, who can professionally operate digital technologies and applications, discovered an essential purpose in using such technologies for creating content. They are, however, only at the start of the path to be able to visualize the processes, thoughts, and information.

To solve several DIYLab problems, the students had to show their skills to produce solutions. They had to read a lot of materials about certain issues, synthesise, compile and organize their work so that everything, including image materials, was properly structured. Students also perfected their work with several types of information sources (text, image, sound), which also contributed to the development of their information skills. However, one of the biggest problems for students at CUNI was working with the source information, and learning from it (external sources, valid data, categorizing of information). In some activities, such as animation of stories or *How I'm becoming a teacher*, the students had the opportunity to develop their socio-emotional skills. The students themselves were aware of the lack of those skills.

It should be noted that some students of UB showed resistance to both the need to search for information, analyse, prioritize and use it for their productions, and for the critical analysis and use of digital tools, because they felt these skills were not related to these particular technologies.

Relation to the curriculum

All the DIYLab activities were incorporated into topics within subjects, so that the activities did not stand out of the curriculum needed to gain credit. In some cases, the DIYLab activities helped the students with their motivation to solve problems, their creative work, and being interested in finishing a successful product.

Autonomous / Self-regulated learning

Independent learning and self-regulation dimensions have underlined the whole process and have been actively promoted, taking into account the diversity of students and their willingness to learn. In this context at UB we found:

1. Groups that worked well independently (with some tutorials they were able to improve their quality).
2. Groups that needed many more rules to advance seemed reluctant to learn by themselves, expressing some uncertainty and were in need of approval from the teachers.

At CUNI, many students had problems with planning and their work layout, which unfortunately led to handing in unfinished or poor quality digital objects.

The content of the DIYLab courses has encouraged the construction of a more reflective and active attitude towards learning on the part of most students.

At CUNI, the students appreciated the DIYLab style of teaching in two aspects: (1) they learned another approach to solve an issue and (2) learned how to properly lay out their work and organize tasks to solve issues.

2.3 Digital competence

In the case of this project, following the recommendations of the European Commission, we consider that "digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet" (European Communities, 2007, p. 7). Digital competences are closely related to the DIYLab project. Also, it is clear that the digital competences are perfected by both teachers and students.

At UB, the implementation of DIYLab has enhanced the development of digital competence and the use of digital tools. This has promoted a continuous and reflective learning on the selection and critical handling of information, and has increased the students' digital expertise, taking most students to search programs, tutorials and/or advice on the Internet for successfully developing the proposed tasks. The most used tools for the development of the DIY digital objects have been Web Site Builder, and the video editing software, PowToon and Prezi.

At CUNI, the students worked with a quite narrow spectrum of hardware and software, which was determined by the technical equipment at school, or in the respective subjects of Bachelor's and Master's degree studies. Most of students involved in DIYLab activities were the students in ICT. In general, it is difficult to describe any improvement of their digital literacy. Based on the outputs, the students were mostly using video, presentation and text editors.

2.3.1 Digital Objects

The important issue was the quality of digital objects, given its public nature once published in the DIYLab Hub. At the beginning of the implementation, it was decided that the criteria[4] that the digital objects must meet should to faithful to the project. In the case of the University of Barcelona, there have been following stages of control:

- While developing the digital objects, members of research group Esbrina[5] helped giving feedback to the teachers involved in the project, in order to clarify those aspects of the DIY philosophy to be taken into account, or not.
- Once the process was finished, in some cases, the teachers evaluated the digital objects based on criteria of quality and consistency presented in class and, in others, the responsibility to select objects to be uploaded in the DIYLabHUB was shared between students and teachers.
- Through the evaluation process, finally, most digital objects produced were uploaded, distributing responsibility among teachers and students, understanding that the latter must also take responsibility for what they produce and have agreed to share publicly.

In the case of CUNI, the teachers decided which objects were to be made public on the HUB. Important aspects for publicizing the objects, apart from fulfilling basic criteria, are also:

- finishing the object in the form of a manual, with analysis and reflection on how to solve certain issues,
- up-to-dateness of a topic,
- adequate quality of the object.

The final control process of digital objects implied the collaboration between the different countries participating in the project. Each partner had a choice to select four or five digital objects within agreed parameters.

2.4 Teaching methods and approaches

To start working with students and placing them in the context of the subject and the DIYLab project, it was necessary to think about how to introduce the proposal and how to motivate them to participate in the process.

The teachers at UB followed the following strategies to do that:

- Emphasize the importance of expressing ourselves through different media (audio, visual, music, symbolic, textual...).
- Show the potential of auto-ethnographic approaches for the education of different groups.
- Discover that the DIY philosophy is linked to the anti-consumerist and punk movements (McKay, 1998; Kamenetz, 2010).

[4] Visual content; English, multi or 'universal' language localization; Relation to DIY; Proper digital format

[5] Research group Esbrina – Contemporary Subjectivities, Visualities and Educational Environments (2014SGR 00632):http://esbrina.edu

- Present DIYLab:
  - Explain and encourage them to explore, what is the origin of the DIY philosophy.
  - View some digital objects, as well as the presentation of DIYHub.
- Explain the European nature of the project, which could open some doors or be important for their curriculum vitae.
- Show how the project can allow other students or people from different areas to learn from / with what they have learned.
- Introduce the subject in a similar mode to the flipped classroom, in order to:
  - Establish a dialogue between their expectations, questions, proposals and objectives of students and teachers.
  - Facilitate the understanding of new concepts when working in the Classroom.
- Avoid redundancy by the teachers, better fitting students' concerns and supplementing what is not understood in the initial search.

Relating regular studies with the DIY philosophy to students was different at CUNI, depending on the teacher and the type of the activity. Some activities required more thorough understanding of the DIY philosophy, and also identifying oneself with it. In their activities, the aspects of DIY philosophy were applied during a semester. This fact did not influence the success of lectures, at least from the teachers' point of view, as we can see in the survey. Teachers state (question Q1) that the educational goals and the philosophy of DIY was fulfilled with the average of 82%.

Master's degree students of educational subjects at CUNI had to explain their understanding of DIY after their activities ended. 31 answers were gathered and the results are for example such:

- A project-oriented activity of students with a constructivist approach to learning. Students had to come up with their own ideas to solve even out-of-school problems.
- During the activities, the students learned to work with digital technologies and make decisions about how to solve issues. Everyone could decide their own way of tackling problems.
- From the educational point of view, even more important than the product itself was the documentation of the procedures, and how they solved problems.

2.4.1 Problems arising during the development of activities

From the teachers' point of view, the main problems in the activities were the lack of time for the students of combined studies. There are only 3 meetings scheduled during a semester and usually in a very short time span. There is no room for self-reflecting and continuous analysis of the problem. Another issue was motivating students to be creative, especially at the early phases of projects' completion.

Most students received, with interest, the proposed activities, and others say that the challenges were too difficult, and that were not able to develop them independently, claiming that more structured classes would help them in the process. Below are listed the most relevant problems / challenges encountered during the implementation of DIYLab:

- Uncertainty caused by the difficulty in understanding the meaning of the project, the concept of knowledge and learning that sustains it, and the demand for the realization of a digital object to visually explain something they had learned for themselves. These events brought about, for some students, a lack of involvement.
- Management of self-regulation: lack of commitment or inquiring attitude by some students in relation to the dynamics of research information independently prior to the class sessions, which led sometimes to a poor debate around the concepts already known, hindering the assimilation of new ones.
- Difficulty to reflect on their own learning processes beyond the WHAT to get to the HOW and WHY, since students are not used to this active inquiring attitude towards learning.
- Lack of knowledge of many digital technologies that will enable to generate digital objects; problems with multimedia contents (audio, video) and with technical equipment (tablets, videocams), and programming languages used to building digital projects.
- Embarrassment when expressing themselves while using video components, especially among students of the Faculty of Education - because text is the standardized format.
- Resistance to move from a passive to a participatory position by some students.
- A certain gap between the rate of teachers and students' learning pace, which was evident in the meta-reflections made by students at the end of the course.
- The majority of digital objects produced were focused on the final research-based, instead of encompassing all processes underway.
- Working with the sources of information (external sources, valid data, information sorting).

2.4.2 Evaluation

In general, students were informed from the very beginning about the evaluation methods, and what was going to be evaluated at the end of the activity. Teachers at UB informed students about WHAT was going to be assessed, WHO would do it and HOW it would be done in the following way.

- WHAT: Two strategies have been used together to evaluate the processes and learning outcomes the different subjects: (1) through continuous assessment, because learning is understood as a ceaseless endeavour; and (2) through learning experiences so that students are capable to consolidate the learning of different topics of the subject matter.
- WHO: Generally they have been the teachers, sometime in collaboration with PhD students. At other times, they have asked students to evaluate themselves through a narrative about their learning in the course, including the qualification they believed deserved.
- HOW: Criteria used has been previously shared with students and redefined with them, reaching elements such as: accompanying activities carried out, the research project, the DIYLab digital object, the degree of participation in class, the level of oral presentations, the meta-reflection on the acquired learning throughout

the course. Some of these points, as shown in the following table, had need of further development in order to facilitate the assessment.

Tab. 4 Criteria for assessment of DIYLab digital object

Criteria for assessing the quality of digital objects	Criteria for evaluating the learning achieved

• Creativity
• Collaboration
• Autonomy
• Reference to learning and teaching elements
• Reflexivity
• Using various communication modalities
• Show different learning contexts
• Locate contextual elements
• Structure the story from a script
• Showing something they have learned for themselves throughout the course
• Visual components
• Make explicit what, how and why of their DIY digital objects.
• External people should understand the message.
• If it is a video, no more than 5 minutes.
	• Ability to reflectively show an independent learning (while attached to the subject) and answer the three questions proposed in DIYLab:
	  • What have we done?
	  • How we did it?
	  • Why we have done in this way?
	• Under no circumstances, they can deliver class notes, but learning paths inside or outside the class related to the field of knowledge.
	• Bibliographical and documentary foundations. Both the conceptual use of literature and references to documents made throughout the process.

2.5 Summary

Students were not used to teamwork, and found it difficult to co-operate with others, so most of them chose to work individually on their DIYLab projects. The whole resulting process of implementation of DIYLab was influenced by both the preparation phase of DIYLab activities within the WP02 and implementing the activities into lectures. It was essential that teachers understood the DIY philosophy and how to incorporate it in education.

The time allocated in some subjects was very limited, especially in combined studies of Master' degree studies (4 weeks of practice during a semester). Unfortunately, it led to not having enough time to evaluate DIYLab activities in groups, and students often handed in their projects just before the semester ended. When possible, the teachers tried to evaluate the experiences of DIYLab of students in the following semester.

In some cases, it was very motivating for students to see their classmates' project already made public in HUB.

The idea of DIYLab will surely be recognized by all the students involved in the project. The most challenging problem was to capture the process of creation, learning and how to describe, visualize and share these processes. Another big problem was not meeting the deadline by students. *"We have come to an agreement, that the preparation for the profession*

of teacher requires visual literacy and that the skills to visualize the processes of learning and mental creation are extremely important."

The following table shows the benefits of learning and teaching practice based on DIYLab model according to teachers' comments.

Tab. 5 The benefits of DIYLab model

UB	CUNI
• The HOW and WHY of learning processes. • The collaborative dimension. • Reflecting on the interest a DIY digital object can have beyond the authors and the course. • Fully integrating the DIY philosophy and the project DIYlab in the subject, trying not to see it as something added, but something that actually merges with the subject matter and the teaching and learning methodologies inside and outside the classroom.	• Variability of topics. • Plenty of outputs are interesting even for teachers • The outputs are overlapping and have meaningful use in the future. • The possibility to use outside-of-school experiences, hobbies etc. • Discovering the possibilities of utilization of digital technologies to document work and learning processes. • Students learn to analyse their procedures of solving problems. • The main benefit is the active involvement of students in work on educational objects the cooperation in sharing materials, manuals and links. • Using the methodological in the pedagogical practice. • Comparing the products and having feedback from classmates.

All the DIYLab activities were done in a maximum length of one semester, which was in some cases too short a time to hand in a DIYLab product of such quality that the teachers had in mind. The quality of outputs and the process of learning of students in the context of DIYLab is a subject to further study, to secure a more effective benefit from the philosophy of DIY in education.

Conclusions

The whole process of implementation of DIYLab was influenced by both the preparation phase of DIYLab activities within the WP02 and implementing the activities into lectures. It was essential that teachers understood the DIY philosophy and how to incorporate it in education. The teachers involved in the project can ensure its sustainability once implemented. In this regard, it generates a reflection on the issue of time slots: even if they were designed to facilitate the implementation of these types of proposals, it would still be necessary to develop a new long-term organizational plan, certainly more interdisciplinary in nature, to enable the curriculum to carry out complex projects such DIYLab.

The implementation of DIYLab in education yields to teachers new ideas and new forms of how to teach, and offers to learners new ways to learn and understand what they learn. Nevertheless, it was a great opportunity for their teachers to re-evaluate the existing approaches to teaching and to use digital technologies to create digital objects, and more importantly, to document the process of learning and the work of students.

All the DIYLab projects were completed at the maximum duration of one semester.

Teachers in primary and high schools agreed that DIYLab activities inspired them to apply active methodologies, and that they improved in managing the group and the developed the ability to react to the apparent lack of control of the group in specific situations.

The most challenging problem was to capture the process of creation, learning, and how to describe, visualize and share these processes. UB used 3 questions for introducing their activities: WHAT, WHO, HOW.

Thanks to DIYLab activities, the students discovered what they are able to do, and that they had the ability to work in teams. They also learned that there is a point in learning new things in a different way from what they experienced so far. Students were more motivated and in general learned to self-regulate themselves and in a more meaningful manner.

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Annex A : Questionnaire for Students

Name of Activity:

University:

Whether you have a feeling that you were solving an interesting topic or issue which interests you and which is necessarily not the content of the given subject

Try to express your opinion on a scale of 1 to 5 (certainly not- definitely):

	1	2	3	4	5	
certainly not	o	o	o	o	o	definitely

Whether you dealt with an interesting assignment which was fun to solve with your classmates

Try to express your opinion on a scale of 1 to 5 (certainly not- definitely):

	1	2	3	4	5	
certainly not	o	o	o	o	o	definitely

Whether you find the cooperation with your classmates pleasant (if you worked alone, do not fill this)

Try to express your opinion on a scale of 1 to 5 (certainly not- definitely):

	1	2	3	4	5	
certainly not	o	o	o	o	o	definitely

What was the result of the activity which you had taken part in, or in which you had been involved?

What would you (with your classmates) do differently or better next time?

What was the biggest problem you encountered when dealing with the activity?

a) When organizing the activity

b) From the perspective of what you've learned or what you would like to learn when dealing with the activity:

c) When using computers, the Internet, mobile phones or any other technical devices:

Was it difficult to solve the task or issue, which you had been dealing with in the activity? Did you have a feeling that you were doing a research?

Did you draw on knowledge which was not directly connected with your specialization or with the given subject? Give examples

Did you learn something new when using a computer, a mobile phone, the Internet, etc.? Did you learn to use a computer program or application, which you hadn't known?

What did you learn thanks to the activity? How did the activity enrich you?

Annex B : Questionnaire for Teachers

Question 1:

To which degree did you manage to carry out and achieve the DIY idea in the activity? Please, apply a scale (0-1-2-3-4-5) similarly like in school marking (put a tick in the box):

0 I did not succeeded anything	1 Excellently	2	3 Quite well	4	5 Badly

Question 2:

What would you do next time better?

Question 3:

Will you apply the DIY activity again in the future with another group of pupils?

Question 4:

What was the worst problem in the DIY activity?

a) From the organizational point of view:

b) From the educational point of view:

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c) From a technical point of view:

d) From the requirements given on the DIY activity (put a tick in the box):

Collaborative learning	inquiry based teaching and learning	transdisciplinary knowledge	Digital competence	Relation to the curriculum	autonomous/ self-regulated learning

Question 5:

What did you learn through the IDY activity? What did the activity bring you, as a teacher, how did it enrich you personally?

Question 6:

What did your pupils learn through DIY activity?

Comments: