D4.5 STRATEGIC PLAN

Project Acronym:	DiDIY
Project Name	Digital Do It Yourself
Grant Agreement no.	644344
Start date of the project	01/01/2015
End date of the project	30/06/2017
Work Package producing the document	WP4 – Analysing how DiDIY is reshaping education and research
WP Lead Partner	ABACUS
Other Partner(s) involved	all
Deliverable identifier	D4.5
Deliverable lead beneficiary	ABACUS
Due date	M24 (December 2016)
Date of delivery	26/12/2016
Version	1.0
Author(s)	ABACUS
License	Creative Commons Attribution ShareAlike 4.0
Classification	PUBLIC
Document Status	FINAL
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 644344.	
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Executive summary

Deliverable D4.5, “Strategic Plan” presents the discussion and conclusions arising from D4.4, “Results derived from data collection and analysis”, and is the final output of Task 4.5, “Generation of strategies to support positive progress”, which was aimed at the definition of appropriate strategies to reinforce positive progress in the application of DiDIY to European education and research on the basis of:

- critical analysis of the outputs of Task 4.4;
- comparison of the outputs of Task 4.4 with the outputs of background research on global trends related to the application of DiDIY in education and research;
- critical analysis of the strategies developed outside Europe to reinforce the above mentioned positive progress;
- collective discussions with the participants.

Taking into account the continuous and fast evolution of the DiDIY phenomenon, the consortium decided to issue this deliverable as a set of broad lines for education stakeholders and to postpone the issuing of any recommendation at the end of the integrative modelling work (WP7) to better exploit synergies coming from the different investigation environments, making DiDIY impact more effective on the society at the large. As a consequence, this deliverable, even if labelled “Strategic plan”, does not include a concrete strategic plan for DiDIY in education, but indications for its definition that may be transferred to policy recommendations by the ongoing integrative modelling work.

Revision history			
Version	**Date**	**Created / modified by**	**Comments**
0.1	2/11/2016	ABACUS	First draft.
0.2	12/12/2016	ABACUS	Second draft for partners.
0.3	22/12/2016	ABACUS	Conclusions section.
0.4	23/12/2016	LIUC	General revision.
0.5	23/12/2016	ABACUS	Executive summary revision.
1.0	26/12/16	LIUC	Approved version, submitted to the EC Participant Portal.

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1. Critical analysis of results of the outputs of D4.4

The study conducted within the framework of DiDIY Project WP4 aimed at contributing to the understanding of the upraising social phenomenon of Digital Do It Yourself in the context of education and research.

As the research has shown, DiDIY is a rather *young* phenomenon, not only because it has been identified recently and it is still under early development, but also because its events are attended mostly by people under 40 with scientific-technological/technical-professional background. People engaging in this kind of activities (the so called “makers”) are considered creative, in a broad sense. At the same time, the general feeling is that DiDIY is scaffolding a new creativity by putting new tools in the hands of the learners. Problems are solved differently compared to traditional off-the-shelf products.

The overall impression of the movement is rather *positive*: the majority of people who answered the Project questionnaire believes that making something with your own hands is satisfactory, challenging, useful to develop competences, useful to be independent, reducing wastes and, in general, a positive activity. DiDIY is seen as an active use of the technology and useful to find a job by the majority of people involved in the data collection with questionnaires. It must not be overseen, however, that part of the informants had negative feelings about it, believing it to be just a game and something good to show off.

DiDIY applied to the classroom emphasises the role of *sharing*. The “work by project” approach, which is often employed in this kind of contexts, seems to stimulate *creativity*. However this is true only in those people already open to it, as this kind of engaging environments might not suit well all kind of students/learners, especially those who tend to perform better working alone or do not really appreciate a higher social engagement. On the same line, many interviewees think that DiDIY communities are prompting new connections with people (digitally and/or physical).

In these contexts, the roles assumed by teachers and learners tend to differ from the traditional, “frontal” arrangements, and students seem to learn better also thanks to the closer *proximity* to the teacher. Not surprisingly, this study confirms that motivation to learning is key. In the majority of the cases these activities tend *not to be integrated in official curricula*; rather, they are considered optional/extra activities to be carried out outside school hours. This is due mainly to the failure of national agencies to effectively recognize these activities as suitable for the official curricula in middle and high schools. It must be noted, however, that teachers themselves have pointed out the intrinsic difficulty of grading such activities. Insofar as formal education will be based on grades, this kind of project- and skill-based activities will be left out, unless a suitable assessing scheme will be available.

The key to have DiDIY fully integrated in schools is to *guide teachers* (who might be afraid of failing in front of students). Their role is to organize project-based activities (hands-on activities), to replace the traditional, passive teaching. The traditional roles of teacher and students seem not to be changes, but new competences are expected from teachers and trainers.

The main obstacle for a widespread adoption of DiDIY into schools seems to be the lack of dedicated *resources for the training of teachers*, where the situation seems to be a bit better for technical schools, while primary and middle schools seem to be left out. In fact, given the affordable nature of activities related to DiDIY, no interviewee identified the lack of resources to

purchase technology as a major barrier to adoption. Interestingly enough, all the current initiatives that we see ongoing in many European schools are driven by the individual initiative of passionate teachers who, in the attempt of finding new stimuli and ideas for their students, approach these spaces (fab labs, maker spaces, etc.). Unfortunately, this means, in some cases, the use of personal time and resources to fill in a structural gap. On the contrary, a top-down, institutional intervention would be welcomed and encouraged. In particular, the main difficulty that emerged from the study was the attitude of teachers towards these new technologies: part of those who appear reluctant to their adoption seem to be hindered by the fear of failing in front of students, whom are often perceived as more knowledgeable than the teachers themselves when it comes to new technologies. With this regard, it has been stressed the need of support teachers in shifting from a “teaching flow” to a “reasoning flow” (“I don’t/can’t know the answers to everything: let’s find out together”). The key element for this new approach to enter schools is to train teachers in moving from a “teaching” prospective to that of a “supporter”. In this sense, their role should move to organize project-based, hands-on activities, leaving behind the traditional, passive teaching approach.

In general, it is noted the presence of an *imbalance towards the male gender* with regard to the involvement in DiDIY initiatives, with the female presence increasing only in art-related activities where the different goals in terms of pragmatics/utility might play a role. However, the main problem seems mostly limited to the initial involvement of girls: once the lab/association has succeeded in engaging them, they tend to remain. Some stakeholders are trying to counter-balance the situation by organizing dedicated camps for girls: in these contexts, a slight facilitator seems to be the presence of female role-models, i.e., female mentors, who contribute to set the overall “mood” of the camp, facilitating the participation of girls. However, the main problem seems still to be related to the cultural background of participants (which could be traced back to childhood).

The major *limitation* of the present study relies in the fact that questionnaires were administered during events related to the (Digital) Do It Yourself phenomenon. Therefore, the data collected might be biased by the previous knowledge and attitude toward DiDIY of the respondents. Similarly, the information collected through semi-structured interviews was obtained only from those people who agreed to be interviewed: these are be persons who, for different reasons and at different title, are already involved in the maker movement and/or interested in DIY technologies.

2. Comparison with the background research on DiDIY space and agents in education and research

The relevance and timeliness of most of the areas of investigation identified in the preliminary research addressed in D4.1, “Research space and agents”, and D4.2, “Complementing background knowledge”, were confirmed against the results of the interviews and surveys.

A significant number of interviewees agreed on the importance of *creativity* as a feature of DiDIY, as explained in Section 1. However, contrary to expectations, most of the interviewees do not (yet) consider students as active “creators” of knowledge: despite their role being considerably more active and engaged in current project-based classes, their acquired knowledge and attitude toward technologies is still described at the level of the end-user (albeit advanced). In this sense, the lack of a sufficient motivation to create knowledge seems to confine their role as, still, “receptors” of knowledge. At the same time, we have seen how nowadays teachers are subject to pressure in order to adopt an innovative approach to education (project-based, experimentation-centered, personalized around the student) and how DiDIY might be well suited to support them in this transition. It is worth mentioning here that, unexpectedly, the initial supposed dichotomy *“STEM vs STEAM”* seems to be resolved in the context of DiDIY, as a significant number of interviews agreed on the artistic nature of certain DiDIY activities (design in particular).

The process of *sharing*, as initially identified, confirms itself as an important issue in the context of DiDIY. However, the WP4 study contributed to highlight some conflicting issues. For example, on the one hand the vast amount of online resources (in form of repositories, blogs and forums, website etc.) presenting DiDIY-related materials is a priceless advantage; however, on the other hand, teachers willing to adopt DiDIY in classes struggle to orient themselves.

Coherently, the reaction of *national institutions* (ministries and ministerial agencies) have been identified by respondents as a central factor for a successful transition. As anticipated, one of the major hurdle in this sense is the lack of a solid assessment/grading procedure that could account for the different nature of DiDIY activities.

Contrary to expectation, DiDIY does not seem to represent neither a positive nor a negative factor regarding the integration of students with special needs. This might be due to the rather premature stage in which DiDIY is in terms of integration in schools.

3. Strategies developed outside Europe: added value

The use of technologies in teaching and learning is spreading in the United States. On the website of the U.S. Department of Education it is written that "technology infuses classrooms with digital learning tools, such as computers and hand held devices; expands course offerings, experiences, and learning materials; supports learning 24 hours a day, 7 days a week; builds 21st century skills; increases student engagement and motivation; and accelerates learning. Technology also has the power to transform teaching by ushering in a new model of connected teaching. This model links teachers to their students and to professional content, resources, and systems to help them improve their own instruction and personalize learning" (http://www.ed.gov/oii-news/use-technology-teaching-and-learning).

Under this general concept, the U.S. educational system is going through a transformation into the DiDIY world. Indeed, the schools can use digital resources in a variety of ways to support teaching and learning, such as electronic grade books, digital portfolios, learning games, and real-time feedback on teacher and student performance.

Some examples of schools already doing this are:

- High Tech High – High Tech High (HTH) is a network of eleven California charter schools offering project-based learning opportunities to students in primary and secondary education. HTH links technical and academic studies and focuses on personalization and the connection of learning to the real word. To support student learning and share the results of project-based learning, HTH makes a wealth of resources available online, including teacher and student portfolios, videos, lessons, and other resources;
- Quest to Learn – This school, located in New York, utilizes games and other forms of digital media to provide students with a curriculum that is design-led and inquiry-based. The goal of this model is to use education technologies to support students in becoming active problem solvers and critical thinkers, and to provide students with constant feedback on their achievement.

There are other interesting examples based on open educational resources that reside in the public domain and are freely available to anyone over the Web. These examples are:

- Open High School of Utah – This school uses open educational resources to create an open source curriculum. To create this curriculum, teachers gather and sort through open source materials, align them with state standards, and modify the materials to meet student needs;
- CK-12 – CK-12 FlexBooks are customizable, standards-aligned, digital textbooks for primary and secondary schools. They are intended to provide high-quality educational content that will serve both as core text and provide an adaptive environment for learning;
- Khan Academy – The Khan Academy is a not-for-profit organization providing digital learning resources, including an extensive video library, practice exercises, and assessments. These resources focus on K-12 math and science topics such as biology, chemistry, and physics, and include resources on the humanities, finance, and history;
- Mooresville Graded School District – This North Carolina district launched a Digital Conversion Initiative to promote the use of technology to improve teaching and learning. In

addition to the use of laptop computers and other technologies as instructional tools, the Initiative led to a shift to digital textbooks which are aligned to the state's standards.

- Vail Unified School District – This Arizona district has replaced textbooks with a digital learning environment that enables every school in the district to take advantage of an online tool to create digital textbooks and support effective teaching.

Penn Manor School District in Pennsylvania estimates the district saved at least $360,000 in licensing fees by using Linux open source software as its operating system and building laptops for the high school's 1-to-1 program (https://www.districtadministration.com/article/dynamic-do-it-yourself-schools): "We initially took the DIY approach because of the cost savings" says Charlie Reisinger, technology director at the Penn Manor district. "The philosophy makes tons of sense for districts that don't have cash. However we also discovered that by using our own resources, we gained the ability to customize and make systems and apps work better for our district.".

By creating its own software and system tools, the district gained control over when to deploy software, updates and bug fixes—rather than reacting to a vendor's schedule. And involving students in software development provides a powerful experience. "The embedded learning that students gain is a thousand times more significant than the cost savings" he says (https://www.districtadministration.com/article/dynamic-do-it-yourself-schools).

Furthermore, there are some initiatives helping to close the opportunity gap by connecting young people with a wide range of learning opportunities throughout their cities, for example Cities of LRNG, that redesign learning for the connected age (https://www.lrng.org), and Hive Learning Networks, a project of the Mozilla Foundation, organizing and supporting city-based, peer-to-peer professional development networks (https://hivelearningnetworks.org).

In Australia, a variety of teaching methods are used, including: teacher-directed learning, student research, group projects and presentations, visual presentations, e-learning and interactive classrooms. The assessment methods may include individual research projects, group assignments, oral and visual presentations, the use of technology, as well as the more traditional class tests and assignments. The Substitution Augmentation Modification Redefinition (SAMR) model, developed by Dr Ruben Puentedura (http://hippasus.com/blog) offers a method of seeing how computer technology might impact teaching and learning. This technology integration is done through four levels:

- *Substitution* – technology is used as a direct substitute for what you might do already, with no functional change;
- *Augmentation* – technology is a direct substitute, but there is functional improvement over what you did without the technology;
- *Modification* – technology allows you to significantly redesign the task;
- *Redefinition* – technology allows you to do what was previously not possible.

In Australia, VicSTEM (http://www.education.vic.gov.au/about/programs/learningdev/vicstem) is a tool bringing together a range of STEM resources, activities and programs, helping early years childhood educators, teachers, learners and families to access the information and services they need quickly and easily. VicSTEM also helps to connect schools and educators with organizations that can provide specialist support relating to STEM learning, including industry, TAFEs and universities.

The *Tech Schools initiative* is part of the Victorian Government's commitment to creating the Education State ensuring use leading-edge technology, discovery and innovation. For this reason, this initiative will invest $128 million to construct and establish 10 Tech Schools across the state.

4. Discussion and conclusions

The DiDIY phenomenon is still rapidly evolving and it is not yet characterized by a clear definition and role in education as well as in other areas of the society. Teachers, school directors, trainers, but also education authorities, are not yet fully aware of the potential of the new technology in enhancing learning processes and, as a consequence, are not adequately fostering its diffusion. On the other side, DiDIY potential to empower teaching and learning well emerges from our fieldwork as well form literature review. DiDIY may configure itself as a disruptive approach to teaching and learning in European formal and informal education settings.

Once confirmed the existing opportunities of the DiDIY in education, the focus needs to be moved on the identification of suitable approaches to spread the concept at the different stakeholders.

Main efforts need to be put in place at the level of education ministries (at national level) and other education authorities (at local level), school directors and teachers.

School directors are, in our opinion, the key target group to be made aware of the new opportunities. They are the ones keeping the decisional power and used to setup educational programs and initiatives at local level. This may be pursued by the spreading of best practices as well as by the setup of effective collaborations with informal education environments that may support schools supplying resources and competences not available internally. Once early initiatives will be in place, it would be easier for the school directors to involve their own teachers, addressing them as tutors of students in specific activities as well as by setting up specific training activities targeting the teachers themselves.

In this frame, ministries and local education authorities may easily act as facilitators, launching suitable national campaigns. On the long term, the may also take care of the adaptation of national education programmes with the aim of exploiting the new technologies not as a learning topic per se but as a facilitation tool to support and allow new teaching approaches.

Teachers are the ones that are entitled to bring the new approach to students. As said before, their training and their understanding of the new opportunities is a key issue. At the current time, most of the existing initiatives are spontaneously setup by individuals that become aware of DiDIY potentialities at personal level and bring such a knowledge in the school. It is again task of school directors and education authorities to motivate and incentive teachers to run the new course.

It is well known that the changes at institutional level require time and efforts, so we cannot expect that the institutionally driven renovation process may take place soon and rapidly. However, the spontaneous movements play a key role in filling this time gaps, setting up initiatives open at students, teachers and citizens at the large. At the end of our analysis, the informal teaching seems to be the most effective way of spreading knowledge on the new DiDIY technologies. Synergies among formal and informal educational environments need to be pursued and exploited.