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# Learning and the Concept of Commons: How Peer-to-Peer can Enhance Learning and Education in the Digital Era

Alexandros Pantazis

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TAL TECH PRESS

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**Declaration:**
Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Alexandros (Alekos) Pantazis _____
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# Õppimine ja ühisvara kontseptsioon – kuidas üksteiselt õppimine saab digiajastul õppimist ja õpetamist parendada

ALEXANDROS PANTAZIS

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# Contents

## List of Publications

The list of author's publications, on the basis of which the thesis has been prepared:

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II Bauwens, M., & **Pantazis, A.** (2018). The ecosystem of commons-based peer production and its transformative dynamics. *Sociological Review*, 66 (2): 302–319. **ETIS 1.1**.

III **Pantazis, A.**, & Meyer, M. (2020). Tools from below: Making agricultural machines convivial. *The Greek Review of Social Research,* 155: 39–58. **ETIS 1.1**.

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## Author's Contribution to the Publications

Contribution to the papers in this thesis are:

I ***Article I.*** The author of the thesis developed the narrative and the educational content of the 25 days' training and performed the educational process. He was responsible for the implementation of the workshop and the writing up of the field observations. The design and structure of the research, as well as the conclusions, were written in collaboration with the co-author.

II ***Article II.*** The author of the thesis was mainly responsible for the synthesis of the case studies according to the main narrative based on the work of the co-author. He was also responsible for the revisions of the manuscript and correspondence.

III ***Article III.*** The two case studies of this publication were the primary research of the author of the thesis. He was responsible for the initial workshops, the collection of data, and the writing up of the case studies. The literature review, development of the narrative and discussion was done in collaboration with the co-author. The author was also responsible for revision and correspondence.

IV ***Article IV.*** The author of the thesis was solely responsible for the idea, research design, documentation of the empirical work, development of the arguments, write-up, revisions, and correspondence of this publication.

V ***Article V.*** The author of the thesis contributed to the development of the narrative, of part of the literature review, and the description of one case study. He also contributed to the sections focusing on the interactions between peers as learners and the role of physical infrastructures in learning.

# Introduction

"The mind must not be likened to a vessel which has to be filled, but to a wood-pile which needs only to be kindled."

*(Plutarch as cited in Westaway 1922, 84)*

From researching and advocating for marine protected areas in the Aegean sea to working as an environmental engineer, and from teaching environmental education to adults and preschool children to representing Greece in Brazil as a social activist for Degrowth, many of my experiences have induced me to realize the importance of communicating knowledge, ideas, and feelings effectively. Often, communicating those ideas effectively can be done when one is on equal footing with others, as compared to a traditional instructor-student relationship.

Meanwhile, information flow is increasing exponentially, and knowledge infrastructures have become an elemental component of today's societies. As Ruta et al. (2013, 1) note, "societies in the 21st century are likely to be determined by the efficiency and depth of their knowledge transfer throughout their education systems and beyond". However, surprisingly enough, what is socially anticipated as teaching often reinforces the causes of difficulties in learning. The competitive nature of schools (Means et al., 2017), combined with the approach of learning as a form of possession to be exploited make learning a commodity, and "like any commodity that is marketed, it becomes scarce" (Illich, 1975, 73). Currently, due to the privatization surge, a wide array of enclosures takes place, threatening to convert learning and education from a resource available to all to an advantage of the few (Korsgaard, 2019; Wittel, 2018). On the contrary, educational commons form an alternative proposal aiming towards the horizon of inclusive and democratic societies (De Lissovoy, 2008).

The commons can be defined as the "social practice of governing a resource" through the institutions that a community of users creates and manages (Tomašević et al., 2018, 74). They manifest today in various formats, from the co-management of natural resources to the writing of open-source computer code and rely on the concept of Peer to Peer (P2P) which is "a type of social relations in human networks, where participants have maximum freedom to connect" (Bauwens et al., 2019, 1).

This thesis is based on two pillars, both permeated by the concepts of the commons and P2P. The first pillar is the educational commons, informed by critical pedagogy and P2P learning. The second pillar comes from the "most significant organizational innovation that has emerged from Internet-mediated social practice" (Benkler, 2016, 91), called peer production which, when based on the commons is called commons-based peer production (CBPP) (Benkler, 2006; 2016). The research question is, thus, whether the organizational and governance characteristics of CBPP can strengthen learning processes towards what I call commons-based P2P learning.

In this thesis, I use desk-based research for the theoretical pursuit of the organizational and governance characteristics of CBPP communities (Article **II**) and for the examination of P2P elements in learning initiatives (Article **V**). Subsequently, I utilize Participatory Action Research (PAR) to gain hands-on experience of CBPP processes and to organize learning workshops that incorporate CBPP characteristics. The underlying aim of the publications was to configure particular characteristics of CBPP and then adapt and test their function in learning scenarios (Articles **I**, **III**, **IV**). The outputs of my research have been accepted as peer-reviewed scientific publications in international journals and have

contributed to the discussion in the fields of learning, sociology, and communication studies.

In what follows, a treatment of the theoretical framework is provided in order to prime the reader for the presentation of the main problem, research approach, case studies, and findings. Therefore, the structure of this thesis is as follows: In Chapter 1 I provide a brief historical account of the evolution of the commons, I describe the notions of P2P and CBPP, and give a short description of CBPP characteristics. In Chapter 2 I discuss education, critical education, I present the approach of educational commons and its dynamics, I discuss learning and introduce the current approaches of P2P learning. In Chapter 3 I introduce the problem and the research question of this thesis, the research approach, methods used and I shortly present the main case studies that constituted my fieldwork. In Chapter 4 I present in detail the CBPP characteristics and analyze their learning potential based on the application of CBPP characteristics in the learning case studies during the field research. Finally, I propose practices for the integration of CBPP characteristics in learning. In Chapter 5 I reflect on the integration of classical and new commons in learning, propose future research steps, and summarize.

# 1. The Commons and Peer to Peer

## 1.1 The Commons

The commons is a triad consisting of a resource, a community, and the management rules that the community forms in order to co-create and co-manage this resource (Bollier, 2014). Hence, we can perceive commons as a "social practice of governing a resource" (Tomašević et al., 2018, 74) through the human relationships and institutions that a community of users creates and manages (Bollier and Helfrich, 2019). This social practice of commons-based governance takes a horizontal form between peers, allowing "human beings to contribute to the creation and maintenance of shared records while benefiting from them" (Bauwens et al., 2019, 29).

The commons is a constantly evolving notion and practice. Since the first hunter-gatherer communities, commons has been fundamental, supporting communitarian social reproduction. However, during the recent period of the industrial revolution, the commons became increasingly invisible, gaining ground again during the last three decades.

De Moor (2008) researches the guilds and commons since the Middle Ages, offering us a detailed historical perspective of their trajectory. Marx indicates that the "enclosure of the commons" (1867/1990, 877) formed a basic element in the development of capitalism and in the degradation of traditional communities. Further, Polanyi (2001) describes how common land was grabbed from small-scale peasants and handed over to big landowners in the process of industrialization. Harvey argues that "accumulation by dispossession" (2004, 116) was not just an initial precondition to the emergence of capitalism, but that the expropriation of common resources was always important and still takes place today. The debate on digital enclosures and the environmental justice movement are just two of the many cases that confirm Harvey's argument. Additionally, Ostrom (1990) observes the successful patterns of cases of commons-based management of natural resources in recent historical periods (1970–1990), triggering theoretical and practical experimentation around the commons in various domains.

Since then, as Tomašević et al. (2018) describe, numerous researchers, scholars, and activists have contributed to an expansion of the concept of the commons in terms of both resources and governance. Regarding resources, a widening of what we perceive as the commons has taken place: from geographically constrained natural resources to globally distributed tangible or intangible "goods" like air, radio frequencies, computer code, language, and culture. Regarding governance, researchers and activists have also led a broadening and radicalizing of the notion of the commons: from a set of steady, collectively enacted management rules of a strictly defined community to an array of dynamic social relations and practices, reclaiming enclosed (statized or corporatized) commons, incorporating the issue of fair access and sustainable use into the debate and looking at power relations, thereby defining commons as a process of political struggle.

Hence, if we could distinguish between classical and new commons although no clear dividing lines exist, the understanding of governance has shifted from the stable rules of small rural communities to encompassing a dynamic multidimensional social process, and that of resources has expanded from merely natural to a spectrum of tangible and intangible means. The practice of commoning, from a process developed through generations of experience embedded in local community traditions, has shifted to a struggle against enclosures at local or global level and a demand for fair access, collective control, and sustainable use, reclaiming the commons (Figure 1).


***Figure 1:*** *The commons as dynamic social practice and struggle (Source: Author, based on Tomašević et al., 2018)*

## 1.2 Peer to Peer

P2P refers to horizontal human relational dynamics and, as defined in detail by Bauwens et al. (2019, 1): "1) P2P is a type of social relations in human networks, where participants have maximum freedom to connect and 2) P2P is also a technological infrastructure that makes the generalization and scaling up of such relations possible (...)". In technological terms, P2P forms "part of the underlying infrastructure of the Internet" (Bauwens et al., 2019, 2) which, because of its structure and functionality, can be seen as a fertilizer for P2P social interactions, allowing for the broad implementation of "massive self-organization to a global scale" (Bauwens et al., 2019, 3). Depending on the use, P2P dynamics can reinforce direct collaboration, while at the same time keep the project's orientation and the final outcomes under the decision and ownership of a minority. However, it may also reinforce a horizontal process from beginning to end. In this thesis we focus on the second case, where all participants are able to shape the P2P process in its entirety, resonating with the concept of the commons.

P2P social relations are currently strengthened by the Information and Communications Technology (ICT) dynamics and have evolved through the practice of numerous commons-based P2P communities demarcating the production process termed Commons-Based Peer Production (CBPP). CBPP is not a marginalized practice, on the contrary, it significantly affects our lives. For example, some of the most prominent examples of CBPP include Wikipedia, the online encyclopedia created and maintained as an open collaboration project, and Free/Libre and Open Source Software (FLOSS), including projects like the GNU/Linux computer operating system and the internet browser Firefox.

Over the last decades, numerous initiatives have created complex tools and artifacts in a CBPP way. Those initiatives, through a long collective process, have developed governance and organizational characteristics for their function that differ heavily from the dominant forms of governance and organization, and call for an alternative societal model that builds on the collaborative elements of physical and digital realities. Those characteristics are presented here briefly, for the convenience of the reader, and will be described in greater detail in subsection 4.1, where their application in learning processes is examined one by one.

The CBPP characteristics (Kostakis and Bauwens, 2020; Benkler, 2016) consist of "distributed networks" where P2P interaction can emerge unhindered; "commons"

(see subsection 1.1.) allow the sharing of resources and the flourishing of collective intelligence; "holoptism" and "equipotentiality" create transparent processes where all peers have access to all information, treat each other as equals, and can engage in projects without prior permission; and "stigmergic collaboration", wherein the actions of peers serve as signals which affect the actions of other peers without the need of direct communication. "Modularity", "granularity" and "low integration cost" constitute additional basic characteristics of the CBPP, where tasks are subdivided into smaller components, lowering the threshold of participation, and efficiently integrating modules back into the final artifact.

Furthermore, "reputation systems" facilitate social recognition within CBPP initiatives. They render visible the quality and quantity of contribution and activeness of peers, as well as the recognition and esteem they receive from their community of peers. Reputation systems support other functions and characteristics of CBPP, specifically "heterarchy" and "meritocracy". In heterarchy, any peer can take the lead of different tasks or phases of a project. There is no single leader subordinating others, but rather a distributed leadership scenario according to the skills of contributing peers; different leaders emerge where and when they are necessary. Meritocracy creates the capability of the community to grant wider responsibilities to members that value them most. Another CBPP characteristic is that of "benevolent dictators", often those who have initiated and (or) contributed considerably to a project and its community. Such persons have greater power over decisions but are accountable to the community via holoptism and reputation systems.

Subsequently, within the governance mechanisms of CBPP, we can distinguish the characteristic in which "leadership is excercized as coordination, not control", as all members are accountable to their peers through the meritocracy process. Moreover, the decision-making process is often made through "rough consensus and non-determinative voting", demarcating a flexible process where space for additional dialogue and understanding is maintained within the community of peers. Additionally, "organizational formalization" is observed in CBPP initiatives in which, when a CBPP initiative expands, some traditional organizational tools are used in its governance without, however, changing the commons-based workflow or the conflict resolution mechanisms between peers. Finally, "cosmolocalism" characteristic demarcates the merge of the global sharing of digital commons with local manufacturing.

CBPP was first observed in the digital realm (Benkler, 2006) and recent research indicates that it can interconnect digital and physical environments via what Kostakis et al. (2015) call "Design Global, Manufacture Local" (DGML) or Cosmolocalism (Bauwens et al., 2019). In DGML, knowledge, code and design are developed and shared globally as a commons, and "manufacturing takes place locally (...) with local biophysical conditions in mind" (Kostakis et al., 2018, 2). In such assemblage, organizational and governance characteristics of physical commons-based communities can mesh with the organizational and governance characteristics of digital common-based communities forming new potentialities. In the following subsections, I will be focusing on the characteristics of education and learning in order to later examine the results from implementing CBPP characteristics in learning processes.

# 2. Education and Learning

## 2.1 Education

The Oxford English Dictionary gives the following definitions for education: “The process of receiving or giving systematic instruction, at a school or university” and “a body of knowledge acquired while being educated” (Oxford Advanced Learner’s Dictionary, 2020). In another English dictionary (Macmillan, 2020), the description of education is: ”someone’s experience of learning or being taught”.

Any attempt to find a definition of education will mostly reveal similar terms as those used above. This allows us to assume that education is related to a process of instructing, teaching, learning, and acquiring knowledge and information. For more than a century now, definitions of education have been questioned and criticized by philosophers, scholars, and educators from different fields. The abundance of studies indicates that any attempt to define education will encounter harsh critics. In this thesis, a discussion on the question “what is education?” will provide an overview of educational theories, focusing on the perspective of critical education. I then discuss the approach of the educational commons as an attempt to redefine education, its institutions, and learning methods based on the notion of the commons.

The etymology of education hinders characteristics that can add to our discussion. The verb “to educate” originates from the Latin “ex” (out) and “ducere” (to lead). From this point of view, education has sometimes been defined as having the knowledge that provides positive development in the personality of the educated, sometimes perceived as the process of revealing talents or capacities of the learner, and sometimes meant a process of acculturation for the continuation of the social and political order. However, most of the above approaches are teacher-centered.

On the other hand, based on scientific developments, educational progressivism theory puts the students at the center, advocating that education aims to provide children with learning methods to meet their needs and solve their problems (Österman, 2016). Educational progressivism theory aimed to initiate social change by organizing a curriculum based on the interests of children and by conceiving the school as an institution that emerged from social needs. In a similar vein, social reconstructionist educational theory considers education as a tool in creating a new society, diagnosing the crisis of modern society, and producing social policies accordingly (English, 2016).

Education is also understood differently by the main political ideologies. In brief, liberalism perceives education as based on the idea that future generations should be formed as successful workers and productive managers: individuals with political and social responsibility (Kiwan, 2016). Education in conservatism is an approach shaped under the idea of transferring values bearing cultural heritage to the new generation and therefore focuses on the preservation of cultural continuity. On the other hand, the goal of education deriving from Marxism theory is to eliminate the imposition of the dominant class ideology on the working class and to prepare individuals in accordance with the economic and social change that would be led by the working class (Tubbs, 2016). Finally, the totalitarian understanding of education is shaped by the goals and the commands of the totalitarian leader (Pató, 2016, 5).

Studying education through the question “why do we educate people?” relates to the questions “what kind of person, what kind of society, what kind of world is expected as a result of education?”. Thus, education is understood as an acculturation process, and

whether it is organized in a formal way or spontaneously through gained experiences, the educated person does not decide what kind of human he will be formed into as a result of this process. What distinguishes an educational activity from other practices is that it is an activity that is motivated by predetermined goals of "other" people, not the learner (Brezinka, 1992, 38). In other words, it is a process in which the person undergoing that process becomes subject to the guidance of other people rather than doing something based on their own initiative.

## 2.2 Critical Educational Theory

A critical view on the foundations of education originated from critical theory, which finds its roots in the writings of post-Marxists and the Frankfurt School, especially in Gramsci and Adorno (Gur-ze'ev, 2010). The birth of critical theory was the result of a reaction to capitalism and its intervention in every area of social life, from culture to education, from art to technology. Thinkers like Marx, Heidegger, Derrida, and Levinas were also influential in the birth of critical pedagogy (Zhao, 2016). The first systematic criticism of mainstream education (Torres, 2019) by critical pedagogy was influenced by the Frankfurt school (Cho, 2016; Fuchs, 2016; Scheuermann, 2007).

According to critical pedagogy, only through liberated people would it be possible to establish a free society. Freire's seminal work continues to influence many generations as one of the most important sources on critical pedagogy. Freire (2000) reacts to the entanglement of students' consciousness, creativity, autonomy, and freedom within the education system. According to Freire, students are reduced to objects in the traditional education system and the teacher-student relationship becomes the relationship of the oppressor and the oppressed. Freire defines the traditional education model as the banking model of education, which is a metaphor used to denote the dominating character of teachers, who deposit the knowledge into the student's mind. Freire proposes that traditional education, in which students are considered a blank page, should be demolished and subsidized by democratic education, in which students would have a voice, and teachers would also learn from them.

In the early twentieth century, Steiner (the forefather of Waldorf Schools) began to criticize the existing educational system on the basis that it does not help students to gain the creativity and free will to construct their own personality (Dahlin, 2017). Later on, Illich (1971) expressed the idea that educational institutions, over a threshold of institutionalized expertise, become counterproductive. Illich proposed that a good education system would be based on three basic pillars: give access to the available resources for whoever wants to learn; connect those who want to share knowledge with those who want to learn; and make it possible for all who want to present or raise an issue publicly to be heard. Illich's critique mainly targeted obligatory mass education and its impact on society at large. He believed that the embedded authority in education prevented the development of free minds and thus that a radical transformation was needed.

From a different angle, Bernstein (2003) studied teacher-student relations and the physical structure of schools, conducting socio-linguistic research on working-class students. He demonstrated that the means of communication conveys culture and helps its reconstruction and reproduction from generation to generation. According to Bernstein, hierarchical relations are embedded in school structures, behaviors, codes of communications and rules, and in the physical conditions of schools; all of which are transmitted to the students from the moment they enter the school. Bernstein

articulated that the hegemonic character and functions of legitimate knowledge produced in the educational institutions formed the origin of the symbolic control mechanism that can be seen in the speech patterns of social groups and classes. Bernstein's main influence was Bourdieu, who dealt with the underlying problems of culture, analyzing it in two central concepts: *habitus* and symbolic violence.

According to Bourdieu, habitus forms "unconscious schemes of thought and perception or dispositions which act as mediation between structures and practices", and is transmitted initially in the family, but mainly in schools (Mander, 1987, 428). Symbolic power can be seen in all sorts of pedagogic spaces, from home to workplace, from schools to mass media. It is the precondition of every pedagogic communication between the dominant and the dominated and conveys the recognition and legitimization of the dominant culture (Mander, 1987).

Critical pedagogy paves the way for the emergence of alternative schools. During the 1960s and 1970s, numerous alternative schools were established with the idea that everybody should have a voice in the school, which means that from administration to the curriculum, students were involved in decision-making processes. Such schools adopted a student-centered educational approach and followed a learning model with a flexible curriculum. For example, they gave attention to students' exploration, connection with the environment and nature, freedom of choice in activities, and learning through experience. Currently, there are several alternative schooling initiatives worldwide. Subsequently, based on the pollination of critical pedagogy with the commons, I will examine the standpoint of educational commons.

## 2.3 Educational Commons

If we perceive education as a resource, then the co-development and co-management of this resource by the rules and institutions that the communities of users form, would transform education into a common resource: into educational commons. De Lissovoy (2011) proposes a conceptualization of the global common(s) as a political project that leads to radical democracy. He perceives the commons "as shared process of social production, as authentic condition for being together in the world" (2011, 1131), suggesting that education should be transformed under the basis of the global commons. Reminding us to "recognize the centrality of education to larger projects of democracy and community building" he emphasizes the role of education as the most important space for experimentation of any social transformation where "the social body slowly teaches itself a new way of being" (2011, 1129–1132).

In the same line, Pechtelidis and Kioupkiolis (2020, 4) describe educational commons as follows:

> The commons in education could animate attempts to transform the substance of our relationship to teaching, learning, research, and institutions of education in accord with the spirit of the commons. Education would be transfigured, then, into a collective good, which is created, governed, and enjoyed in common by all parties of the educational community.

As Pechtelidis and Kioupkiolis (2020) propose, we can envision an education organized "as an institution of the commons" such that the management of knowledge and education will be a collective process and educational communities will organize and coordinate among themselves on a basis of the "democratic participation process" (2020, 4). Such a learning community should rely on the values of contingency,

experimentation, and surprise in the sense that when learning is co-produced and co-managed by all members of the community, its trajectory cannot be developed in a linear and predefined way from one stage to the other; therefore, openness to the creativity of the community and trust in an outcome that cannot be fully anticipated is prerequisite (Pechtelidis, 2020; De Lissovoy, 2011).

Against the enclosures of education, Biesta (2011) supports the idea that education is a public good and at the same time a field of struggle that must be appropriated by commoners in order to be transformed towards a democratic direction. However, apart from the threat of enclosures, education is often neglected in the commons discourse (Pechtelidis, 2020), whereas it should be considered as one of the main dimensions of the commons alongside the social, economic, and political.

Current research in student communities (Pechtelidis, 2020) indicates that Ostrom's principles of the commons can be implemented within learning processes. More specifically, Pechtelidis (2020) estimates that Ostrom's principles about clearly defined boundaries, graduated sanctions, and conflict resolution mechanisms can be used in learning communities with positive results. However, no concrete experiments have taken place yet: researchers urge (Pechtelidis and Kioupkiolis, 2020) for more practices to be produced and tested on a basis of learning as commons in order to develop concrete implementation methodologies of Ostrom's principles in learning.

## 2.4 Learning

The brain's functionality still remains a mystery: it forms a complex, multifaceted process not yet clearly defined by science; hence, learning has a pluralism of different approaches and interpretations. For instance, a biologist could see learning as "reconfigurations of the brain's neural network" (Ruta et al., 2013, 7), a physicist might assume a decrease in the system's entropy, a sociologist could perceive it as the ability to transfer what you have learned to others and an old-fashioned schoolmaster might specify it as the ability to learn a thick book by heart.

Ruta et al. define knowledge as "the collection of information units" and learning as "a process of information transfer from the more to less informed source via an imperfect channel" (2013, 7). Although this is an incomplete way to frame learning, it helps us get to the micro-level of learning "transactions". Those "transactions" are extremely complex, involving not only the transfer of knowledge as information but also the transfer of linguistic or non-linguistic knowledge, embodied, audiovisual, sentimental, spiritual, or technical knowledge.

However, it seems that learning is not a matter of knowledge transfer alone but that the most crucial part might be the way that the transferred knowledge is wired into the rest of the learner's knowledge and experience. For example, when learners read something, they read somewhat different texts, because what has a specific meaning for the teacher will have different interpretations for the learners (Blomqvist, 2006). Learning is much more than just a cognitive phenomenon; the learner actively uses previous concepts, knowledge, experiences, and feelings, and the interaction with their sociocultural environment (Lave & Wenger, 1996; Blomqvist, 2006; Sawyer, 2014). This is why each individual perceives something slightly different and connects it with their sense of self in a unique way.

Moreover, learning is what constructionism describes as a process where learners build knowledge structures based on their active involvement in real-life projects (Papert, 1994). Learning takes place when people are involved actively in tasks, projects,

discussions and through their gained experiences, are constructing meaning(s) (Miyake & Kirshner, 2014). Under this perspective, knowledge emerges in specific situations from which it should not be separated: what is called situated learning (Rogoff & Lave, 1984; Ackerman 2001). Further, learning is nested in communities of practice (Lave & Wenger, 1996), from classrooms to computer-gamer forums, and is embedded in social processes: it is the evolutionary trajectory of a person's identity from a newcomer to a participant of a community that creates learning through interactions (Lave & Wenger, 1996). Perceiving learning embedded in social interactions is in close proximity to the essence of P2P. However, social interactions always concern issues of power relations, transparency, and ethics (Lave & Wenger, 1996), which can be tamed by introducing commons principles and characteristics into learning.

## 2.5 Peer to Peer Learning

The Cape Town Open Education Declaration (2007), signed by 280 organizations and thousands of individuals, in its first paragraph states that "educators and learners create, shape and evolve knowledge together, deepening their skills and understanding as they go". Nowadays, we can find P2P learning dynamics in various sectors. Several libraries and museums have created spaces with the aim to empower creative activity, resource-sharing, and active engagement through P2P processes. Toronto University, for instance, has a P2P program to mentor faculty members on peer observation and peer evaluation of courses, students, and teaching (Peer-to-Peer (P2P) Mentoring for Teaching Pilot Report, 2017). Moreover, the Michigan Depression Center has developed a "Peer-to-Peer Depression Awareness Program" that organizes students to attend "peer mentorship classes" (Parikh et al., 2018, 489) and to learn how to communicate depression-related knowledge and treatment to their peers, with positive overall results.

The United Nations has been elaborating on the notion of P2P learning since 2003, focusing on its complementary use in broader youth health training programs and campaigns. The "Sub-Committee on Peer Education" of the United Nations Interagency Group on Young People's Health (Zielony et al., 2003, 10) defines P2P education[1] as follows:

> Peer education is the process whereby well-trained and motivated young people undertake informal or organized educational activities with their peers (those similar to themselves in age, background or interests) over a period of time, aimed at developing their knowledge, attitudes, beliefs and skills and enabling them to be responsible for and protect their own health.

Indicative to the interest that P2P education has aroused in large organizations, contributors from the United Nations Population Fund and the U.S. Agency for International Development led by a researcher from Harvard University, in 2005 developed a guide for standardizing the use of P2P education in health projects (Deutsch et al., 2005).

P2P education is given the same definition that the United Nations used since 2003, for instance by SALTO-YOUTH in 2006, by the European Peer Training Organization in 2016, and by the Organising Bureau of European School Student Unions in 2020

1 The UN report as well as other resources use both the terms "P2P" and "Peer" for education and learning. From the context, it is understood that they refer to the same concept, that of P2P as horizontal social relations.

(Green & Tammi, 2006, 2; Toolkit for Quality Peer Education, 2016, 19; Vabuolas et al., 2020, 4). Additionally, the European Peer Training Organization explains that "the method of peer training is based upon the belief that young people deliver a message to their peers that is often more credible and efficient than when it is delivered by authority figures" (Toolkit for Quality Peer Education, 2016, 22).

A more advanced example of P2P learning is the case of "Peeragogy"[2], an online community active since 2012 that has collaboratively written "The Peeragogy Handbook" (Corneli et al., 2016), including 39 contributors and focusing on creating "a flexible framework of techniques for peer learning and peer knowledge production" (2016, 3). As stated in their text (2016, 3):

> The Peeragogy Handbook is a compendium of know how for any group of people who want to co-learn any subject together, when none of them is an expert in the particular subject matter – learning together without one traditional teacher, especially using the tools and knowledge available online.

The Peeragogy Handbook crystallizes the practical experience of the peeragogy community and investigates how people can create, share, and use knowledge together. The handbook examines case studies and deals with issues of cooperation, participation, and organization of the learning process. Moreover, it touches upon "peeragogical" assessment, the technologies and platforms used, and the patterns of practice. Those patterns are interesting for the practice of P2P learning but are produced solely in the specific context of this community. The Peeragogy Handbook mentions that it draws from the experience and principles of FLOSS and CBPP (Corneli et. al, 2016), but without any further explanation on what specific elements it uses from those domains.

A community where P2P learning practices combine digital contribution with physical interaction is the Peer to Peer University (P2PU)[3]. P2PU creates and sustains learning communities around the world, trains facilitators on how to organize their own P2P learning networks and develop open educational resources and software tools (Article **V**). Moreover, P2PU develops infrastructures, such as the P2PU's facilitator handbook or a web platform, in order to empower community members in organizing P2P learning circles.

As we have seen so far, P2P learning is used by many organizations in business, public sector, and grassroots communities. This does not necessarily mean that the whole learning process always takes place under a framework based on the P2P dynamics (Article **V**): P2P learning can have a "front end" based on the P2P scheme (i.e. horizontal and collaborative), while at the same time the "back end" might be closed and hierarchical. For example, do the learners decide on the issues to be learned in a P2P way and on the final outcome of the process, or is it the institution that runs the workshop that decides? The aim of a P2P learning workshop may be to increase the competitiveness of the employees of an institution or to reduce the training costs of a health training program. Therefore, issues that concern the process but also the aim, purpose, and final outcome are crucial and have to be part of a P2P learning process.

As depicted in this subsection, within a broad spectrum of organizations, the focus of P2P learning is often confined to the energizing elements of P2P interactions (i.e. exercises, games, ice-breakers) with no decision over curriculum and is mostly kept

2 http://www.peeragogy.org/

3 https://www.p2pu.org/en/

within the narrow context of overcoming youth resistance to tutors. Similarly, in an academic publication dealing with P2P recognition of learning in open education, Schmidt et al. (2009) from the United Nations University although referencing Benkler (2006), he does not delve into the particular characteristics of P2P that are analyzed in Benkler's work but rather remains on the generic inspiratory idea of P2P learning. It is not by chance that the definition of P2P education for major institutions has remained unchanged for more than seventeen years (Zielony et al., 2003, 10; Vabuolas et al., 2020, 4).

The Peeragogy Handbook and P2PU are some of the grassroots initiatives that perceive and practice educational commons and P2P learning in a way that is in close proximity to the approach of this thesis. The patterns that the Peeragogy Handbook analyzes are a step forward, as it offers practical tools from conceptualized experience, but still, these are based on observations from one specific group without systematized research on other cases. Moreover, the Peeragogy Handbook, although mentioning that it draws from the experience and principles of FLOSS and peer production, makes no further elaboration and those elements are not obvious in its processes. However, the Peeragogy Handbook and P2PU both develop a form of P2P learning that is innovative and productive therefore further research should be made in order to determine if CBPP characteristics are integrated into their processes.

It is hoped that one-way learning from teacher to student is gradually replaced by a richer interaction that better reflects today's reality, where peers exchange knowledge under different forms of coordination based on openness and autonomy. In this way, each person operates not only as a passive receiver but, depending on the circumstances, shifts from learner to teacher, chooses from a multitude of stimuli, integrate or reject knowledge and skills, chooses learning groups and partners, and shares knowledge in personal, unique ways. Such a fluid learning process can be greatly benefited by looking into the organizational and governance elements of CBPP initiatives.

# 3. Problem, Research Approach, and Case Studies

## 3.1 Problem and Research Question

As discussed, the educational commons approach perceives education as a collective good that is created and managed by each educational community as a whole (Pechtelidis & Kioupkiolis, 2020). However, although there are various proposals for the implementation of educational commons, the majority of experience gained from communities of commoners is left unutilized.

Moreover, the implementation of the P2P concept in learning, called P2P learning, is practiced widely in various contexts from large institutions to grassroots communities. Nevertheless, while there is rich academic research describing the functional characteristics of CBPP (which is a type of P2P interaction), P2P learning is confined to the incorporation of only the rough characteristics of P2P: the collaborative, non-hierarchical elements of interaction and the concept that learning can occur between peers. This thesis's research question is if learning is strengthened when the characteristics of CBPP are incorporated in the former's processes.

This thesis elaborates on the learning potentiality of CBPP characteristics; adapts and implements them in different learning scenarios; and draws conclusions on the learning results and on the use of those elements in learning processes. Figure 2 depicts the "genealogy" of the contribution of the thesis. The term commons-based P2P learning forms a synthesis of the educational commons learning processes informed by the functional characteristics of CBPP.

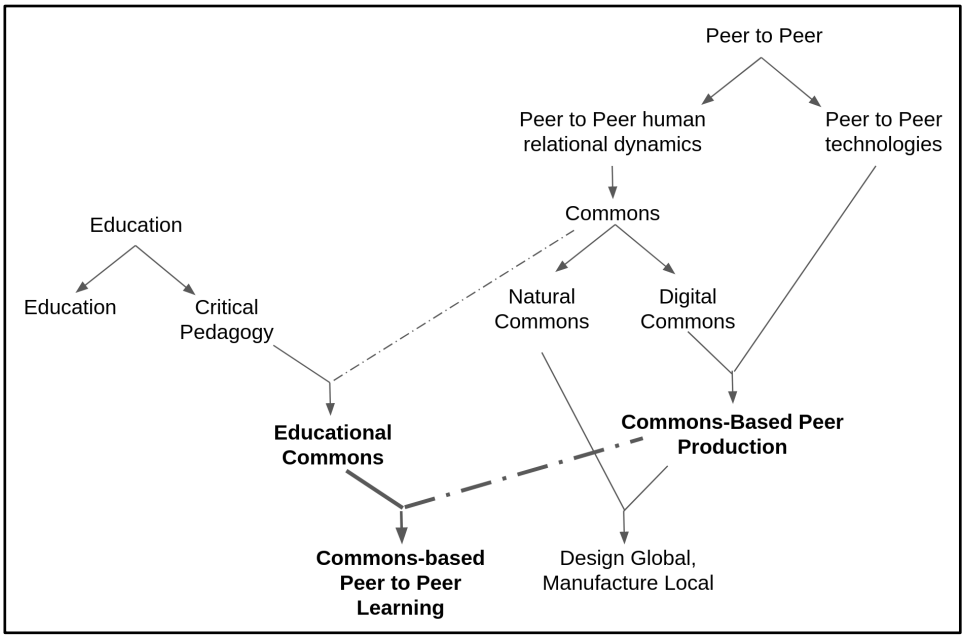


***Figure 2:*** *Illustration of the thesis contribution for commons-based P2P learning (Source: Author, based on Means et al., 2017; Kostakis & Bauwens, 2020)*

## 3.2 Research Approach and Methods

The case study and PAR approaches were deemed most appropriate as basic research approaches of this thesis because they provide advantages for the wider socio-technological context of the subject (Yin, 2003; MacDonald, 2012; Reilly, 2010). Moreover, quantitative methods (standardized questionnaires) were also used in one publication (Article **I**). Table 1 provides a bird's-eye view of the approach, methods, and questions of each article:

***Table 1**: Research approach, methods, and questions of the articles of this thesis*

| Article | Research approach | Methods | Research questions |
|---|---|---|---|
| **I** | PAR & Questionnaire | Literature review, Participatory observation, standardized questionnaire | Do open-source technologies empower non-formal education? |
| **II** | Case study | Literature review, Participatory observation | How are the CBPP communities organized in terms of community and supportive institutions? |
| **III** | PAR | Field research, Participatory observation | How to democratize knowledge and technology in small-scale agricultural production? |
| **IV** | PAR | Field research, Participatory observation | How can non-formal education and P2P learning reinforce the role of educational commons? |
| **V** | Case study | Literature review, Participatory observation | What are the platforms, tools, and methodologies that characterize and facilitate P2P learning? |

This research project aims to create a theoretical and empirical line of analysis on the learning potential of CBPP characteristics. Therefore, through bibliographical review and secondary sources, I explored the existing literature on education, learning, and CBPP.

Subsequently, I engaged in case study research to examine the characteristics of CBPP communities regarding decision making, task distribution, problem resolution, group dynamics, and other functional elements. This was done by reviewing academic resources and by actively participating in CBPP initiatives. Finally, I organized three PAR case studies by facilitating learning processes and workshops that integrated some of the observed CBPP characteristics.

The primary data collection (Brown & Hale 2014) of this thesis comprises direct observation either during participation in communities of practice or during the organization of workshops and learning activities (Articles **I**, **III**, **IV**, **V**); focus groups with a small number of community members for moderated conversations (Articles **III** & **V**); interviews during personal meetings with community members, makers, learners and educators (Articles **III** & **V**); primary data sources and content analysis (Articles **I**, **II**, **III**, **V**), and surveys utilizing questionnaires aimed at participants of the workshops (Article **I**).

The mutual involvement of the researcher and the participants in knowledge production via PAR methodologies often creates strong bonds between them (Kim, 2016). This leads the researcher to feel not like an outsider, but rather an active member of the learning process. PAR is used to assign the researcher as a facilitator who contributes towards the effective implementation of an event, arousing the interest and engagement of others (Wadsworth, 1998). Such a research approach was in line with the characteristics of openness and horizontality that CBPP communities. Moreover, PAR can assimilate bottom-up approaches and has at its core the needs of the communities under research; therefore, it may develop effective practices (Fors and Moreno, 2002; Fraser et al., 2006). Such development was one of the main objectives of this research.

Conversely, a significant criticism against choosing case study research and PAR methodology is the presence of subjective bias; that is, the possible preconceptions or arbitrary judgment of the researcher due to their deep involvement in the researched phenomenon. Flyvbjerg (2006) asserts that case studies might reveal researchers' erroneous preconceived views, assumptions, and hypotheses, obliging them to reconsider their previous assumptions. Flyvbjerg's criticism was taken into consideration by juxtaposing the data gathered with other researchers' work (in the literature review and in the field) and by advocating for more research in the specific context.

Moreover, I perceived and used PAR as an experiential approach that aims at the empowerment of grassroots communities (Okali et al., 1994) and at the mutual involvement and learning of both researchers and participants, to which I dedicated considerable time and effort. This type of research follows an iterative reflective cycle, which means that, after suitable preparation via literature review and field research, actions are taken and reviewed, resulting in new actions throughout the learning process (Article **I**).

I followed the above logic both within the process of each article and research task and in the overall trajectory of this thesis. Thus, I first looked into the characteristics of open-source technologies and learning (Article **I**). At the same time, I started researching the political economy of the commons and P2P (Article **II**), which deepened my understanding so as to conduct more thorough research into the learning potentialities of participatory design and the making of tools (Article **III**). Article **III** took considerable time to complete because it was concerned with the initiation and management of a CBPP community and of a rural makerspace. Moreover, the practice of teaching about the commons led to the creation of a participatory educational workshop that formed the research subject of Article **IV**. Finally, some of the experience gathered from P2P communities, technologies, and learning led to the book chapter presented in Article **V**.

## 3.3 Description of the Case Studies

In this subsection, I briefly describe the three main PAR case studies used in my publications (Articles **I, III, IV & V**) in order to prepare the reader for those concepts embedded in Chapter 4, where the CBPP characteristics are associated with their use in learning based on the findings from those case studies.

### 3.3.1 The 3Ducation Project (Article I)

Through a 25-day experiential learning workshop for high school students called the "3Ducation Project", a blend of open-source technologies, CBPP characteristics, and the Kolb learning cycle (Kolb, 2015) were tested, documented, and discussed. Students engaged in designing and manufacturing 3D-printed models of natural and cultural heritage elements. The artifacts carried messages in Braille and were provided to people with visual impairments, with a threefold aim: to enable communication among persons with and without visual impairments; to motivate visually impaired persons to engage in ecotourism; and to empower students to participate in learning scenarios that integrate open-source technologies and CBPP elements in learning processes.

### 3.3.2 The Musical Chairs Game (Article IV)

Inspired by the "Musical chairs" children's game, I developed an experiential learning workshop to introduce the commons through commoning (Article **IV**). This learning workshop consisted of four parts.

In the first part of the workshop, participants were asked to play the classic musical chairs game in which they walk or dance around chairs (in each round there is one chair fewer than participants), and when the music stops, the participant who fails to find a place to sit is expelled from the game. This game repeats in rounds until there is one winner. In each round of the workshop the participants were asked to think of the chairs as a resource and reflect on their experience; for example, to discuss the feelings of the excluded participants, or the characteristics that competition gives in the group dynamics.

During the second part of the workshop, the rules were "hacked" to resemble the principles of the commons, i.e., participants now walk or dance around the chairs, and when the music stops, everybody has to find a way to be seated; nobody is expelled (even though, again, in each round one chair is removed). In this version, the community has to cooperate and find ways to share the resource; i.e., the chairs. This game also repeats in rounds and ends when the facilitator estimates that further reducing the number of chairs will not add to the learning process. In each round participants are asked to reflect on their experience; for example, to discuss the feelings of inclusion or the innovative practices that the community devises in order to share the scarce resource and offer a way to be seated for all its members.

In the third part, the principles of the commons are explained in a basic form. These principles must be used in the fourth and final part of the workshop, where participants are asked to create commons-based resource management rules for a number of contemporary problems. This workshop is mainly based on the knowledge and observations arising from the community of participants.

### 3.3.3 Peer to Peer Agricultural Communities (Articles III & V)

The Design Global, Manufacture Local (DGML) model utilizes P2P dynamics to produce functional artifacts that satisfy local needs. Through the DGML process, global digital collaboration creates designs for tools, while manufacturing takes place locally, enhancing the learning-by-doing concept. With these considerations in mind, I realized two field trips in order to research the CBPP learning characteristics of DGML communities (Article **III**). The first trip was to an agroecology group called Melitakes. Melitakes have collectively built a small harvesting machine that does not exist in commerce. The Melitakes case explored how we could open-source the design of this harvesting tool so as to share the manufacturing knowledge with the broader community of agroecology. The democratization process of technology showed that it entails strong learning dynamics.

The next research trip involved participating in a workshop organized by the L'Atelier Paysan[4] cooperative, which builds open-source tools together with farmers. During this visit, I had the chance to get actively involved and observe the organizational model of this group and the learning dynamics of open-source technologies.

Finally, during the last two years, I have had the privilege to be involved in the setting up and facilitating the Tzoumakers community[5]. Tzoumakers is a CBPP rural community in northern Greece that organizes participatory design and manufacturing workshops for agricultural tools. This community consists of farmers, stock-breeders, beekeepers, and woodworkers; but also programmers, designers, engineers, researchers, and many more. In the context of this thesis, Tzoumakers served as a field for the experimentation and observation of commons-based P2P learning scenarios. Tzoumakers' primary focus was not learning; they tried to find solutions to their practical needs, and while doing so they engaged in P2P lifelong learning activities.

4 https://www.latelierpaysan.org/English

5 http://www.tzoumakers.gr/english/

# 4. Contribution

## 4.1 Commons-based Peer to Peer Characteristics and their Use in Learning

In this subsection, a description of CBPP characteristics drawn from CBPP practices is followed by an explanation of their use and value in learning scenarios based on observations from their application in the case studies (Articles **I, III, IV & V**), as well as their manifestation in other relevant initiatives when deemed useful. In as much, the integration of CBPP characteristics across a range of learning scenarios within these cases offers valuable insights into the potentiality of the new commons to enhance learning and democratize education.

First, I analyze and discuss CBPP characteristics as presented by Kostakis and Bauwens (2020). Namely: Distributed networks; Commons; Equipotentiality; Holoptism; Stigmergic collaboration; Modularity, granularity and low cost of integration; Heterarchy; Cosmolocaism; Benevolent dictators; Reputation systems. Then, based on experience from the field, I choose to add some of the CBPP characteristics that Benkler (2016) describes because they complement the latter. Namely: Meritocracy, Leadership as coordination, not control; Organizational formalization; Rough consensus, and non-determinative voting.

Particularly relating to the application of CBPP elements in learning is Benkler's comment that the patterns that he describes allow prolonged experimentation, intrinsic and mixed motivations and freedom of action "much longer than would likely be thought efficient under more traditional systems" (Benkler, 2016, 112).

**Distributed networks**

Distributed networks allow for peer production to emerge, giving autonomous agents the freedom to choose their behavior, contribution, and engagement without external obligations. Kostakis and Bauwens (2020) distinguish distributed networks from decentralized networks, as the latter consist of obligatory hubs.

CBPP communities can differ from the traditional communities of the natural commons (Arvidsson et al., 2017), in which strong interpersonal relations and concrete motivations are rooted in a common set of values and traditions. Usually, in CBPP communities, individuals can "join or drop out of practice-centered projects" and "remain connected through commitment to abstract values" (Arvidsson, 2017, 62). Such an aggregation of individuals can have in common different interests and motivations: making, learning, socializing, and so on. Given that the P2P process allows such a loose association, individuals feel free to join. It is worth noticing, however, that this open spirit and loose connections often create long-lasting communities because participants enjoy exactly that type of association.

In the case studies, such relations based on distributed networks were seen between the communities of Tzoumakers, Melitakes, and L'Atelier Paysan (Article **III**). Members from the Tzoumakers community offered to help members of Melitakes without knowing the latter personally, in order to render knowledge about making a tool broadly available. Similarly, in the L200 collective space in Zurich (Article **V**) different persons and groups use the space in a distributed participatory way, having a minimum level of obligations.

Distributed networks allow communities and people to collaborate in an open form of learning with maximum freedom to choose their participation, contribution, and engagement. Thus, knowledge and experience spread easily with no strict preconditions or external constraints.

**Commons**

People contribute voluntarily to creating resources that are openly shared and governed by the productive community (Kostakis & Bauwens, 2020).

When learners co-create and co-manage their educational resources and processes according to their skills, intentions, and knowledge, the feeling of ownership naturally rouses a sense of caring for the resource, and thus a deeper engagement with learning emerges. Moreover, as mentioned in the Peeragogy Handbook, "people who gain experience comprehending problems together, build trust" (Corneli et al., 2016, 65).

In Article **I**, students kept a diary of the process, difficulties faced and solutions given during the creation of the 3D printed artifacts in order to create an openly shared documentation that might help other learning communities to repeat the educational experience. While there is no information as to whether any other community tried to reproduce the learning process, the idea of helping others stimulated the social reflexes of the students, engaging them in organizing and presenting the knowledge produced by their community as a commons.

In Article **III**, numerous communities, by sharing the design of agricultural tools as commons, provided the opportunity for distant communities to learn how to cope with some of their everyday problems and mobilized them to share their own local knowledge and innovations.

The four projects described in Article **V** create and share physical and digital infrastructures as a commons in order to facilitate knowledge sharing. Each initiative defines its own way of sharing knowledge, design, experience, or tools, rendering them common resources. For example, P2PU creates its own digital infrastructure for content sharing (a web platform and a forum), while collaborating with existing infrastructures (public libraries) for the sharing of physical spaces.

**Equipotentiality**

Arising from the merging of the terms "equal" and "potential", equipotentiality is an organizational principle whereby everyone can engage in a project without requiring a prior judgment or permission from an authority. Thus, "the capacity to cooperate is verified in the process of cooperation itself" and "the filtering is a posteriori, not a priori" (Kostakis & Bauwens, 2020). The term *a posteriori* is also important: credentialism is usually a prerequisite for participation in mainstream processes, while P2P projects reverse traditional evaluation by introducing "anti-credentialism" and developing ways to shift filtering and quality control to the end of the process increasing participation (Kostakis & Bauwens, 2020).

As is described in Article **V**, the main idea is that one can learn better when one is brought into the position of teacher. Equipotentiality removes the barriers of participation and predefined roles and welcomes everyone to contribute and share. P2PU is a characteristic example (Article **V**): anyone can upload a course and organize meetings about it; even further, you don't have to know the subject of the course you want to organize, just the will to learn about it. The Peeragogy Handbook drawing from Rancière (Corneli et al., 2016, 64; Rancière, 1991) mentions that "participants are more in touch with an equality of intelligence than an inequality of knowledge". In a similar

way, equipotentiality's perspective encourages the participation of learners and forms a substrate that helps mutual respect and appreciation to grow. However, in order to truly welcome everyone to participate, *a posteriori* filtering is essential: this in turn requires appropriate infrastructures and processes.

**Holoptism**

Holoptism can be seen as the reverse of panopticism (Foucault, 1977): all members of a P2P community have access to all information about the project in which they participate. Access to information is not restricted based on membership hierarchy but, on the contrary, access for all is basic, cultivated, and enhanced via the creation of tools and processes made for this purpose. Information can be referred to in terms of contribution, aims, project metrics, and documentation (Kostakis & Bauwens, 2020).

This is a basic characteristic that renders meritocracy and stigmergy (see below) feasible. Holoptism accelerates the learning process and the co-creation of learning materials because all information and knowledge are accessible to everyone. Everything is open and transparent, facilitating trust, contribution, and decision-making in the learning communities.

However, holoptism can be easier to achieve in digital communities where giving access to information can be a matter of uploading content – though this is not always the case – while opening access to information in learning and making communities (as described in detail in Article **III**) may demand a considerable effort.

**Stigmergic collaboration**

Ants and bees use stigmergy, a term originating from the merging of the Greek words for "signal" and "work". From simple to more sophisticated ways, stigmergic collaboration happens when the actions of peers create signals that can affect the actions of other peers. Stigmergic collaboration is reinforced by holoptism (Kostakis & Bauwens, 2020).

Stigmergic collaboration is observed when there is no central coordination of tasks, but rather users and groups independently add and edit content or initiate new projects. This permits a learning community to be fluid and vibrant. Stigmergic collaboration can reduce the number of decisions required to be taken by using direct democracy processes in communities of commoners, thereby decreasing the time and effort required for the decision-making process.

Moreover, as quality control happens at the end of the process (*a posteriori* filtering), with stigmergy, everyone can see what is missing and contribute accordingly. In this way, a learning community does not need the commands of a central authority in order to participate in a learning group or to propose a new learning activity, but rather each individual can find their place and role intrinsically. For example, the communities of Articles **III** and **V** can see what other members organize and act on respectively. More specifically, the Tzoumakers community downloaded the designs of a tool that was created and shared openly by the L'Atelier Paysan community, made a synthesis from other designs of similar tools that were found on the internet, and created an updated version of the tool. Therefore, stigmergically, Tzoumakers considered an improvement for a tool that was shared via L'Atelier Paysan's digital library and, without needing to discuss, grant permission or establish a special agreement, they were free to improve, adapt, build it and update this library, contributing autonomously to a global learning-and-making web in regard to rural tools.

**Modularity, granularity, and low cost of integration**

In order to have a multitude of contributors, a project is divided into smaller components (modules). In this way, peers can choose the desired type and level of engagement with a project and undertake the modules that they want to deal with depending on their available time and energy. Granularity is the process of reducing a project to the smallest possible components so that the threshold of participation becomes lower (Kostakis & Bauwens 2020; Benkler, 2006). Low cost of integration means that the modules are broken down in such a way that recomposing them to the final artifact can be done (relatively) easily (Kostakis & Bauwens, 2020).

Modularity is observed in learning projects where tasks are segmented and the community autonomously undertakes parts that later merge together (Wikipedia being the flagship example of this, in our context). Modularity can also be useful for the engagement of learners in areas that they find more intriguing and fit to their available time and energy, and for tailoring different learning paths depending on the skills and interests of each learning community.

Modularity was used in Article **I** where the final project was subdivided into tasks and students were free to choose where to participate according to their skills and interests, though they were asked by the facilitator to participate in a minimum of two modules. Modularity is also widely used by the L'Atelier Paysan collective (Article **III**) where the construction of each tool is divided into different parts and a visualized mechanical design guide leads the makers through concrete stages, first for the making of sub-parts and then for their assembly into bigger parts for the final tool. Finally, in Article **IV** the modular, four-part structure of the learning workshop allowed effective adaptation to different audiences.

**Heterarchy**

Heterarchy originates from the merging of the Greek words meaning "other" and "lead". Heterarchy can comprise a multitude of hierarchies where different peers take the lead in different timeframes, tasks, and/or networks. It can be also described as "dynamic hierarchies" or "distributed leadership" (Kostakis & Bauwens, 2020). Pechtelidis (2020) describes heterarchy as a hybrid form of governance that can combine top-down reversible hierarchies and bottom-up peer governance dynamics. This dynamic leadership springs from the reputation systems and meritocracy that are described later in this subsection, and from the distributed freedom of segments of a project to give the lead to different peers depending on the circumstances (Kostakis & Bauwens, 2020).

In heterarchy, different people can come to the fore if they want to teach, contribute, make, or initiate specific projects/initiatives. The community accepts that people have different skills and therefore different people can lead different parts of a project. This is extremely useful in learning contexts, rendering acceptable and facilitating a process of transition from learning to teaching and vice versa, where different peers can take the lead and share skills and knowledge when they feel that they can contribute to the collective building of knowledge. Pechtelidis (2020) argues that commons-based education projects can be subject to continuous quality control through a type of heterarchy supported by the tools of the pedagogy of documentation and the pedagogy of listening, something that is worth experimenting with, as it proposes a different method of *a posteriori* filtering used in digital communities.

**Cosmolocalism**

Cosmolocalism comes from the merging of the terms "cosmopolitanism" and "localism", attesting that all humans belong to a single community (Corradetti, 2017; Taylor, 2010), and advocating for "the convergence of the global digital commons of knowledge, software, and design with local manufacturing technologies". Cosmolocalism proposes that "what is light (knowledge) becomes global commons, and what is heavy (machinery) is local and shared" (Kostakis & Bauwens, 2020).

Educational commons can easily identify with Cosmolocalism. Knowledge can be shared globally and produced both globally and locally, holding ties with local communities. Pedagogically, this concept can be inspiratory, mobilizing contributors to participate in an open, fair, and sustainable, global learning community proposal. Article **III** exemplifies this concept, as communities of practice learn how to solve their problems locally and, by sharing knowledge, code, and design collaborate globally with other communities, mutually helping each other.

A lot of maker communities also join forces to solve global problems. One recent case is the emergence of many global-scale open collaborative projects developing Covid-19 related knowledge and equipment (Coronavirus Tech Handbook, 2020; Open Source COVID-19, 2020). This comprised a rich community that shared knowledge developing tools from open-source 3D-printed face shields to open-source respirators. Such global communities collaboratively created forums and web-based technical handbooks where knowledge was developed in a stigmergic P2P way while they also formed local networks for the distribution of equipment from the makerspaces to the hospitals.

Two more concepts that are worth mentioning, albeit not registered as CBPP characteristics, are the concepts of the benevolent dictators and reputation systems (Kostakis & Bauwens, 2020; Kostakis, 2010).

**Benevolent dictators**

The benevolent dictators may derive from some of the heterarchical leaders of a project. As a concept, it is usually based upon their substantial contribution and care for the project and the community. Due to holoptism, when a benevolent dictator loses its virtue the most common reaction in P2P communities is "forking", that is to copy the work done so far and start anew with a similar project.

The concept of benevolent dictators can be a useful concept for the transition from mainstream forms of teaching (Torres, 2019) to commons-based P2P learning. As an educator and facilitator, I am aware of the practical difficulties that commons-based P2P learning processes might have in terms of horizontality and equipotentiality. In some cases, a commons-based P2P learning process can be mostly led by a facilitator/teacher with the goal that the community at some stage will no longer need the facilitator and that the latter will be integrated as an equal peer.

**Reputation systems**

Social recognition is one of the basic elements of CBPP communities, forming one of the main incentives for participation. Reputation systems render social recognition visible and hence have a core role in the social structure of the community. Moreover, reputation systems are based on measuring the quality and quantity of contribution and activeness of peers[6]. One of their uses is as indicators for communal validation when

6 Caution should be taken regarding the handling of personal data use.

members are chosen by the community to undertake wider responsibilities, being granted increased power over decisions. They are therefore a tool for meritocracy.

Reputation systems have not been observed in the current research. I assume that this is mainly due to technical differences: in digital communities, even though there is still a strong need to "quantify and objectify the reputation" (Arvidsson et al., 2017, 35), it is easy to spot major contributors, for example by using the amount of code contributed or the number of responses to other members' comments; while in open learning communities this cannot be quantifiable and visible with the same ease. In making communities, where things are more tangible, recognition of the most skillful members can be easier; which, however, is not always the most important factor of the whole process. In the case of P2PU (Article **V**) a reputation system works as an aggregation of both physical and digital members' activities, including elements from organizing training in libraries to creating and uploading new learning circles online, whilst P2PU is also at a stage of developing those processes further (personal communication, 2020).

Benkler (2016, 111) identifies some "norms-based governance structures that peer-production enterprises have in fact developed to deal with these competing goals under the institutional and motivational constraints characteristic of peer production". He observes that commons-based governance did not solve problems by a re-emergence of hierarchy but with "the utilization of flexible, overlapping, indeterminate systems of negotiating difference and permitting parallel inconsistencies to co-exist until a settlement behavior or outcome emerges" (2016, 111–112). Some of the characteristics that Benkler analyzes are described below with a view on their learning potentialities.

**Meritocracy**

Meritocracy denotes situations in which community members making significant contributions are recognized by the community, which grants them wider responsibilities together with increased power over decisions (i.e. authority) (Benkler, 2016).

Meritocracy uses reputation systems as a foundation of its function and allows CBPP groups to escape the idea of absolute horizontality, which often degrades differences to an unproductive uniformity. Instead, with meritocracy, horizontal groups sustain their richness and not only accept existing differences but utilize the best parts of them. Meritocracy forms an important element for P2P learning communities as it gives the power to authorize others to take the lead. It is used for shifting members between learner and educator or facilitator roles, rendering teaching a shared activity.

For example, in the learning process of Article **I**, after breaking down the project into modules, students choose to join some modules. This process resulted in the more skilled students, for example in computer software, to be given the lead in the group of 3D model making, and those more skilled in engineering to be given the lead in the group of 3D printing. Those students helped others in the same group to understand the process and to undertake tasks. In another case of meritocracy, members of the Tzoumakers community (Article **III**) who are skillful in communication and socializing were given the keys of the place, being granted more responsibilities than usual by the community.

**Leadership as coordination, not control**

Those who bear more responsibilities and leadership via the meritocracy process exercise their role over others as coordinators rather than as hierarchically superior authorities (Benkler, 2016).

The experience of how others behave when in the role of coordinator and the embedded transparency in the process induces coordinators to behave in an egalitarian, collaborative way. This, of course, lies in the hands of each community, which sets the rules and limits via democratic processes. In terms of learning, this is a foundational characteristic of commons-based P2P as it creates a spirit of mutual trust where participants feel comfortable in applying meritocracy and giving the lead to people they appreciate, knowing that coordinators are unlikely to exploit their power but that, even if they do, there are ways for the community to react (e.g. the forking process previously mentioned).

Often, as the coordinator of the Tzoumakers makerspace, I tried to be modest in my interventions, leaving space for the community to step in and waiting for individuals to undertake tasks. "Let things fall down" is a common quote among facilitators. Another case that portrays this spirit occurred during the realization of the workshop described in Article **I**: a technical problem of the 3D printer in the last days of the workshop put the completion of the project at risk. I waited for the student team that was working on 3D printing to try to solve it and, indeed, students asked for help in 3D printing open-source forums and managed to repair the tool. On the final evaluation some students noted that when they realized that the facilitator didn't have all the solutions for the problems they grew stressed but, at the same time, this mobilized them to undertake responsibilities and take the lead in various tasks. They commented that this was one of the best parts of the training. Similarly, a contributor to the Peeragogy Handbook mentions that when applying a P2P learning case study in a public high school in California a student noticed that "we learn best when adults take away the crutches and there is no safety net" (Corneli et al., 2016, 39).

**Organizational formalization**

Larger projects use more traditional organizational tools in their governance without, however, allowing this to affect workflow or the conflict resolution mechanisms between peer contributors (Benkler, 2016).

This is something not observed so far in the realized case studies, as they consist of small-scale projects. However, it is an interesting characteristic regarding the wider scale of commons-based P2P learning and the broader discussion regarding the expansion of educational commons. Organizational formalization might be something not to be scared of if the inner processes can continue to be P2P and based on the commons.

**Rough consensus and non-determinative voting**

Rough consensus and non-determinative voting intend to balance between two "extremes": first, the seeking of absolute consensus in a group might block the process due to the raising of vetoes (especially in large groups) and, on the other hand, absolute majoritarian voting might lead to frustration of minorities and/or downgrading the discussion to determining what is "right" or "wrong". Rough consensus and non-determinative voting seek an intermediate decision-making space between those two polarities in which, in all cases, there is space for additional dialogue and twists (Benkler, 2016).

This practice challenges and enriches the perception of direct democracy and consensus. It also resembles Ostrom's sixth and seventh principles (1990) (i.e. use of graduated sanctions for rule violators and low-cost conflict resolution mechanisms). Rough consensus and non-determinative voting allow large communities to collaborate because usually reaching a concrete point of consensus is extremely difficult. Moreover,

in all communities, there are occasionally violations of commonly decided rules. When a community is prepared for such cases (through accepting rough consensus and non-determinative voting concepts), they are much easier to deal with and can cause fewer internal problems than when rule violations or deviations are perceived as a severe disrespect to the community. During the cases studied such a practice was not exercised explicitly, although tolerance among participants and decisions was present.

## 4.2 Suggestions for the Integration of Commons-based Peer to Peer Characteristics in Learning

Based on the practical experience gained from the case studies, I try to shortly suggest how the above described CBPP characteristics can be integrated into commons-based P2P learning processes. To begin with, one's participation in CBPP communities is always valuable because it helps in familiarizing with the radically different governance elements and human communication codes of those processes. It is important for someone to gain the tacit knowledge that they will later have to put into practice in learning activities.

External and internal distributed networks can be creatively used in a learning group. For example, mapping and connecting commons-based P2P learning initiatives and open-source repositories of knowledge, courses, and ideas can be useful. Further, the interaction between learning groups creates what Illich described in the 1970s as "learning webs" (1971, 32). Specific digital platforms can be formed based on the needs and functional characteristics of commons-based P2P learning. Regarding the internal function of distributed networks in groups, participants can be encouraged to form subgroups and connect freely between them with no central nodes or control.

The learning process can be perceived as a common resource that has to be co-created and co-managed, in terms of both content and process, and this should be explained repeatedly, as should also be reflected in the learning stages. In such a case, there is the freedom to choose different learning paths and to co-decide outcomes, but there is also accountability to the whole team. Practicing commons-based P2P learning is in itself a learning process in which all participants need to be trained progressively.

Moreover, the facilitator and/or the group of learners can empower elements of heterarchy and meritocracy to emerge, both by granting leadership to different individuals in different tasks and by stepping back, creating space for others to take action at various points of the process.

Equipotentiality is enhanced by distributing tasks and allowing people to shift between them. Making different tasks visible is also important so that people or groups will organically join in. Equipotentiality can be embedded in the common codes and cultures of learning, like the principles of equality.

Holoptism requires the constant, active sharing and opening of information and processes. This can be done in various ways, using digital tools (i.e. web platforms, group chats) and physical tools (i.e. common shared spaces where any activity and task becomes easily accessible and visible; fixed boards where relevant information is placed). However, tailored tools for holoptism in education should be researched and developed.

There are specific tools enhancing stigmergic collaboration in digital communities and it would be compelling to research and create similar tools to facilitate stigmergic collaboration in learning communities. Such stigmergic tools for collaboration would be based on holoptism and concerned with process and interaction tracking and tools where everyone can see the advancement of the collective learning process. Those tools need

caution regarding common versus personal space, making sure no one feels that their private sphere is violated.

Modularity should go through all stages of the process, and in some cases can be initially designed by the facilitator or by the whole learning group. In frugal conditions, modularity can grow organically as the more efficient solution when the group seeks the best way to advance its project. Group work, openness, and freedom at the level of engagement are important factors for modularity to grow.

Reputation systems also require caution regarding personal data and space. Usually, reputation is a social process that naturally evolves within a group. However, formalizing it with tools that render (physical or digital) actions visible can enable an estimation or expression of appreciation of contributions and behaviors. There are advantages and disadvantages to formalizing reputation systems: when formalization of reputation systems is absent, informal reputation systems emerge that might lead to problems related to the tyranny of structurelessness (Freeman, 2013). In such a case, informal hierarchies grow and subgroups carry out authoritarian and bullying attitudes of arbitrary evaluation that are difficult to control as they nest under the space of democratic discourse. Formalizing reputation systems can be difficult both at the decision and practical level because for example some practices or intangible actions will inevitably be left unmapped. Therefore, further research on existing reputation systems within digital communities and on reputation growth within learning communities might prove useful in the attempt to create corresponding functions in commons-based P2P education.

Finally, as explained in section 4.1, Benkler's CBPP characteristics can enrich the democratic and participatory character of the learning process. Rough consensus and non-determinative voting demand both prior discussion and praxis on smaller tasks before applying them to critical processes. The familiarity of participants with direct democracy and collective decision making can be important but also may be a source of resistance towards such "fluid" ways of governance. Trust and the values of contingency, experiment, and surprise that Pechtelidis (2020) mentions can support those characteristics.

# 5. Conclusions

CBPP is reshaping how we produce, how we learn, and how we communicate and relate to each other. It already forms part of our lives either indirectly within a large number of applications and infrastructures underlying many functions of our societies (from webserver software and Wikipedia to open science) or by directly affecting the lives of the numerous active members of CBPP communities. When we produce, learn, and communicate in a commons-based P2P manner, we celebrate the collaborative and inclusive elements of human nature.

During this thesis, learning scenarios that incorporated CBPP characteristics were tested in various setups in universities, NGOs, high-schools, eco-festivals, makerspaces, and social centers, reaching a broad spectrum of participants. This commons-based P2P learning concerned training about open-source technologies, collaborative design and construction of agricultural tools, and the notions of the commons. In all contexts, I observed empowerment of the process towards both learning *per se* as well as towards enhancing the emancipatory and democratic characteristics of learning.

CBPP initiatives can be considered as places where commons-based P2P learning happens to a great extent (Ye & Kishida, 2003) and this probably explains why their characteristics function well when applied in learning communities. However, for commons-based P2P learning to evolve into an integrative approach, further hands-on experimentation is needed, combined with a robust and transparent interdisciplinary scientific research. For example, it is important to better understand the function of CBPP characteristics from an educational point of view and also to research the impact of such characteristics when applied in long-term educational processes. Subsequently, research on the functional characteristics of commons-based communities that are principally focused on learning is rare and should be strengthened. It is also crucial to realize more commons-based P2P learning workshops with the aim to develop concrete methodologies and protocols for the integration of CBPP characteristics in learning processes.

Furthermore, an institutional framework enabling commons-based P2P learning to be integrated into mainstream education and into educational commons allowing the latter to expand to a more comprehensive process would benefit both education and the commons. The examination of the institutional characteristics of P2P learning communities like P2PU and Peeragogy is deemed useful in this direction.

Classical commons like those that Ostrom researched and outlined with her set of eight design principles (1990) certainly form a source of inspiration. However, these principles are based on research made during the ’80s and ’90s; hence they refer mostly to the co-management of natural resources by geographically small, strictly defined groups of people (Article **IV**). Therefore, the adaptation of those design principles in today’s learning processes should be made with careful consideration. On the one hand, such principles of the commons derive from universal characteristics of social interaction which also form the basis of current learning. On the other hand, today’s cases of the commons are much more complex, combining physical and digital networks and carrying multiple localities, different power dynamics, governance rules, and social struggles. Moreover, knowledge and learning, as resources that are strengthened rather than depleted when their use increases, have intrinsically different management and governance processes than the tangible natural resources to which the classical commons apply (Article **IV**). Therefore, educational commons, without forgetting the

lessons learned from the classical commons, should mainly delve into the functioning principles of new commons-based initiatives, integrate their processes, and create learning communities that will merge and utilize the best out of the classical and new commons.

In a global digitalization process accelerated by the recent pandemic, the future of learning in schools, universities, libraries, and noninstitutionalized learning communities remains an open issue. CBPP communities utilize collective intelligence at a global scale, favoring non-antagonistic characteristics in producing human relations, knowledge, code, design, and artifacts that are regenerative towards the social fabric. This thesis argues that integrating CBPP characteristics in learning can help to avoid a sterile digitalization of learning (De Lissovoy, 2011), can empower mainstream education and, at the same time, can form a concrete approach for the further realization of educational commons as described by Biesta (2015), De Lissovoy (2011), Pechtelidis and Kioupkiolis (2020) and others.

If the ends do not justify the means but rather the means create ends (CollectiveAction, 2016), we cannot anticipate peaceful future societies while applying education systems that are based on competition and exclusion. On the contrary, looking into successful collaborative communities of commoners, systematizing their processes into commons-based P2P learning, and applying the needful institutional innovations towards this direction can lead us to an educational paradigm for, by and through the people that might, eventually, bring a similar world: one for, by and through the people.

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Tallinn, 2021

Alekos Pantazis

## Abstract

## Learning and the Concept of Commons: How Peer-to-Peer can Enhance Learning and Education in the Digital Era

Learning faces major challenges and transformations, with educators and academics in need of new forms of teaching able to engage participants whilst adapting to rapidly changing societies. Additionally, the digitization process demands novel and innovative hybrid forms of teaching and learning that impose further challenges.

If we perceive education as a resource, then the co-development and co-management of this resource upgrade education into a common resource: into an educational commons. Despite the great potential of educational commons, much of the valuable insights gained from the collaboration and learning practices of communities of commoners worldwide have been left woefully unutilized. Additionally, Peer to Peer (P2P) learning, widely practiced by institutions and initiatives, albeit of great potential, is often confined to its basic elements, those of horizontal and collaborative human dynamics.

This thesis utilizes the experience of commons-based peer production (CBPP) communities for the benefit of educational commons and P2P learning. Using case studies and participatory action research, I investigate the implementation of CBPP communities' functional and organizational characteristics in learning processes towards what I call commons-based P2P learning. In this thesis, the experimentation with the above concepts across various learning scenarios calls for the integration of CBPP characteristics in learning that can benefit mainstream education, educational commons, and P2P learning.

## Resümee

# Õppimine ja ühisvara kontseptsioon – kuidas üksteiselt õppimine saab digiajastul õppimist ja õpetamist parendada

Õppevaldkond seisab silmitsi raskuste ja muutustega – õpetajad ja akadeemikud vajavad uusi õpetamisviise, mille abil oleks võimalik osalejaid kaasata ning samal ajal kiiresti muutuvate ühiskondadega kohaneda. Lisaks nõuab digiteerumisprotsess uudseid ja innovaatilisi õpetamise ja õppimise hübriidvorme, mis toovad kaasa täiendavaid piiranguid ja proovikive.

Kui haridust nähakse ressursina, siis selle ressursi ühine arendamine ja ühine haldamine õppijate kogukondade poolt muudab hariduse ühisressursiks – hariduslikuks ühisvaraks. Haridusliku ühisvara suurest potentsiaalist hoolimata on suur osa üle maailma eksisteerivate ühisvara jagavate kogukondade koostöö- ja õppetavadest saadud väärtuslikest teadmistest kahjuks kasutamata jäänud. Lisaks piirdub see üksteiselt õppimine, mida institutsioonid ja algatused laialdaselt kasutavad, oma märkimisväärsele potentsiaalile vaatamata sageli vaid põhiaspektidega – horisontaalse ja koostööl põhineva inimsuhtlusega.

Selles doktoritöös kasutatakse võrdsetel alustel ühistootmise kogukondade kogemusi haridusliku ühisvara ja üksteiselt õppimise edendamise huvides. Kasutades juhtumi- ja osalustegevusuurimist vaatleb autor võrdsetel alustel ühistootmise kogukondade toimivus- ja organisatsiooniliste omaduste rakendamist õppeprotsessides saavutamaks seda, mida ta nimetab ühisvarapõhiseks üksteiselt õppimiseks. See doktoritöö toob välja, et eelnevalt esitatud kontseptsioonide katsetamine erinevates õppeolukordades on näidanud, et võrdsetel alustel ühistootmise aspektide integreerimine õppesse võib tuua kasu tavaharidussüsteemile, hariduslikule ühisvarale ja üksteiselt õppimisele.

# Appendix

**Publication I**

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# 3D printing as a means of learning and communication: The 3Ducation project revisited

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ABSTRACT

This research project explores to what extent the utilization of open-source 3D printers and 3D design software could serve as means of learning and communication. The principles of non-formal education aligned with the concept of constructionism are used to create an experimental educational scenario focused on geocultural tourism for persons with visual impairments. This paper documents our experience and presents our findings from a 25-day long project, which took place in Zagori, northwestern Greece. 11 high school students from Portugal designed and manufactured natural and cultural heritage artifacts carrying messages in the Braille language. The objects were then handed to people with visual impairments with a twofold aim. First, to enable the communication among persons with and without visual impairments; and, second, to empower students to participate in training projects through open educational procedures. We conclude that open educational practices can boost students' active engagement in educational processes. Finally, 3D printing encourages a meaningful communication among people with and without visual impairments via the tangible exploration of geocultural components.



## 1. Introduction

The development of learning theories and practices globally justify their characterization as objects of extensive research. Social and collective processes within teaching procedures are currently targeted to alienate the hierarchical constraints of knowledge production (Kemmis and McTaggart, 2005). Student-centered approaches, including the constructionist learning theory and open, non-formal educational practices, are used as means to facilitate student's active involvement in learning (Blikstein, 2013). Moreover, the integration of 3D printing technology in teaching inaugurates new ways of personal expression, fostering students' creativity and experimentation (Huang and Lin, 2016).

This paper focuses on the implementation of an educational scenario of non-formal education aligned with the concept of constructionism. It builds upon a critical making research project, which took place in two Greek high schools (Kostakis et al., 2015). The main goal of this paper was to explore how 3D printing can electrify various literacies and creative capacities of students.

In the context of our project held in Zagori, northwestern Greece, 11 Portuguese students manufactured 3D printed bridge and canyon artifacts of the local region handed to persons with visual impairments. This work attempts to explore to what extent open-source technologies and 3D printing could serve as a means of learning and communication among persons

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with and without visual impairments. The educational scenario was then presented to Greek educators with the aim to discuss our findings and trigger awareness of the application of open educational practices in teaching.

As far as the structure of this article is concerned, a short review of the corresponding theoretical background is presented. The methodological part follows with a description of our methodology and research questions. Then, we narrate and discuss our findings from both students' and educators' perspective. Finally, we summarize our conclusions and culminate with suggestions for future research.

## 2. Theoretical background

In the framework of developmental psychology, Rousseau's invention of childhood provided a breakthrough in the research field of education (Boone, 2017). Thenceforward, contemporary educational practices have been treated with skepticism, while the need for democratic education has been recognized (Soomro et al., 2010). Bearing in mind the fact that our networked world impinge on the way that societies are organized, educated and developed, alternative ways of transforming the educational landscape have been explored (Kemmis and McTaggart, 2005).

Towards this goal, international communities are moving towards non-formal education settings. The concept dates back several decades and differs from formal and informal learning. Formal learning focuses on hierarchical, teacher-centered approaches and promotes standardized, academic knowledge production (Ngaka et al., 2012). On the other hand, informal education refers to incidental accumulation of experience or skills deriving from daily life and interaction with the environment (Dib, 1988). Non-formal educational practices, located somewhere in the middle of the two above-mentioned concepts, are open, innovative and adaptable to the changing conditions and individual needs.

Aiming to drift apart from schooling as a prevailing way of learning, non-formal education attempts to make knowledge accessible to those who are not enrolled in schools (Yasunaga, 2014). The main purpose of non-formal practices is not certification but the acquisition of knowledge and skills through participation, observation and communication (Souto-Otero et al., 2013). The content of a non-formal educational procedure is basically practical, while its delivery modes remain flexibly structured. Non-formal educational programs are usually small-scale, short-term and entail specific purposes.

Despite the non-negligible potential of non-formal education, concerns about its effectiveness have been raised. The short duration of non-formal programs in combination with their preclusion of broader national education may create the impression that, unlike formal, non-formal education is insufficient (Yasunaga, 2014). However, having realized the importance of gaining knowledge outside institutions, the conjunction of the different educational types matters rather than their counterpositioning (Rogers, 2004, p. 234). Thus, non-formal education could be viewed as complementary, supplementary and/or alternative to formal education, which enhances social cohesion and individual capabilities (UNESCO Institute for Statistics, 2012).

In an effort to increase the possibilities for effective learning through experience, non-formal educational settings are correlated with the concept of constructionism. The development of the constructionist learning theory by Seymour Papert (1980, 1993) was an important movement towards the active involvement of students in education. In the vein of many prominent scholars in the educational philosophy (for example Maria Montessori, Lev Vygotsky, Paulo Freire or John Dewey), Jean Piaget developed the constructivist learning theory, which defines learning as "building knowledge structures". Constructionism extends the idea of constructivism by constructing and publicly share objects via conscious and felicitous actions (Papert and Harel, 1991, p.1).

Instead of making deposits of information into their minds, students interact with the environment and gain knowledge rooted in their experience (Ackermann, 2001). Students build objects rather than consume knowledge, being involved in hands-on explorations which boost their experience and inventiveness (Papert, 1993; Ackermann, 2001). An indirect impartation of knowledge occurs combined with collaborative and social activities that accompany the educational procedure. Considering the tight relationship between education and social values, a collective learning process could lead to a culture of sharing and open collaboration (Temple and Moran, 2011, p.195; MacDonald, 2012).

Beyond traditional educational approaches, where students could not see themselves as makers, constructionism provides the appropriate context for collaboration, communication and creative learning. Students engage vigorously in the discovery of solutions especially in meaningful problems, which enhance the educational outcomes (Cavallo, 2000). Within such an environment, teachers act as eager facilitators who consult students and race against the school bell with the aim to spur learners' self-motivation.

To achieve the full potential of constructionism the importance of students' participation emerge. Attracting students' interest plays a vital role in the rise of positive outcomes, taking into account students' inner incentives for learning beyond competition (Wadsworth, 1998). In an attempt to satisfy students' need for communication and collaboration, discussions around the utilization of technology in teaching arose.

In the framework of constructionism, Papert, as an enthusiastic proponent of technology, pioneered the penetration of digital tools in learning institutions (Blikstein, 2013). Since the 1980s, Papert spread the powerful ideas of the Logo programming language and made robotics accessible to children. Information and Communication Technologies (ICT) were acknowledged as tools able to construct personal experience, enable human interaction and manufacture powerful artifacts within self-driven educational settings (Schelly et al., 2015).

In the contemporary era of ubiquity of digital fabrication technologies, the implementation of relatively low-cost 3D printers into training courses has become a focus of research (Nemorin and Selwyn, 2016). A new way of individual expression which fosters students' creativity and experimentation surfaced (Huang and Lin, 2016). Objects can be designed through a computer-aided design software or even a scan of existing objects, using open-source digital tools and additive manufacturing technologies (Kostakis et al., 2015; Rayna et al., 2015).

Utilizing 3D printing in education posits students' ability to view things from various angles so as to perceive 3D modeling techniques. A systematic learning context to educate learners so as to become competent to create their own models is required (Huang and Lin, 2016). Through their participation, students acquire skills, increase their self-esteem and apply their knowledge to further improve the results. However, the risk of the "keychain syndrome" due to easy endeavors handled by students has been highlighted (Blikstein, 2013). To reap the benefits of using technology for educational reasons, students should be impelled to undertake complex projects, which help them enhance their creativity.

Delving into the ethics of the open-source/commons-oriented concept (Bauwens, 2005; Benkler, 2006) the association between open-source infrastructures and the commons-oriented concept is appreciable. Technologies with free and open-source hardware (e.g. Arduino micro-controller, 3D printers) or software (e.g. Moodle, free encyclopedia Wikipedia) can be easily examined and modified, catalyzing the openness of the educational process (Kostakis et al., 2015). Peer learning towards a shared purpose within educational institutions can be interrelated with societal development and co-creation of value. Therefore, students have the opportunity to acknowledge and further develop their inner positive motives and need for cooperation.

## 3. Research objectives and methods

First, this paper attempts to investigate the communicational potential of 3D printing among persons with and without visual impairments. People with visual impairments could experience geocultural tourism of the Zagori region via the exploration of 3D printed objects. Second, this paper aims to enable students to grasp the idea of 3D design and printing through open educational practices as part of a living experience (Papert, 1993; Dewey, 1997; Conole and Ehlers, 2010). To this end, we extend our educational scenario by engaging educators willing to test, criticize and implement similar methods in their teaching.

From the abovementioned objectives, sub-questions regarding the reform of contemporary educational environments emerge. Through alternative scenarios, the possibility of handling current problems observed in schools arises, including the lack of students' participation and critical thinking skills. Furthermore, educators could become more aware of the importance of collaboration and communication as meaningful values within an educational process. Thus, education could be approached from different perspectives with a view of ensuring the continued comprehensive development of learners.

According to Verschuren and Doorewaard (2005), our research framework is concretized through the following flowchart (Fig. 1). Similar to the work carried out by Kostakis et al. (2015), our project is a case study which involves high-school students. However, while in their case the students were allowed to manufacture 3D objects of their own choice, there was a definitive goal presented to the students in our project. The communicational potential of 3D printing among persons with and without visual impairments was investigated. Namely, 3D printed artifacts of natural and cultural heritage elements that compose the local identity of the Zagori region were manufactured by the students with the aim to, first, boost students' engagement in the educational procedure and, second, empower people with visual impairments to explore geocultural tourism via their interaction with the students.

Participatory Action Research (PAR) was utilized in our training scenario to facilitate students' active involvement in education through collaborative practices. This method was developed as a research endeavor focused on organizational conversion, co-learning and participation (Greenwood et al., 1993). It aims to emancipate people from the constraints of current

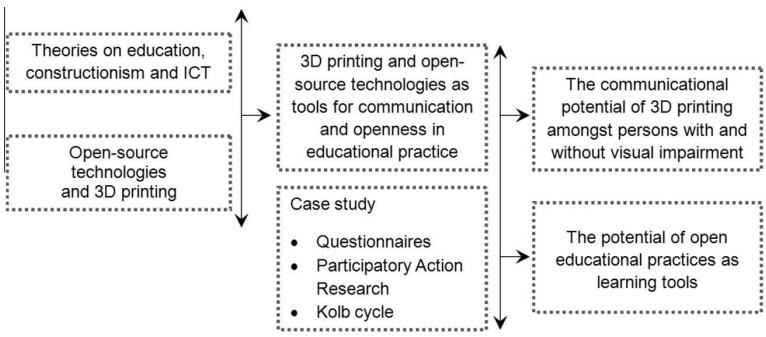


**Fig. 1.** Schematic representation of the research framework. The vertical arrows stand for the "confrontation" of particular issues, from which a conclusion (the horizontal ones) can be drawn.

hierarchies of knowledge production and disrupt inequitable social relations through mutual involvement and collaboration of the participants (Kemmis and McTaggart, 2005).

Transitioning from the linear model of conventional research into PAR, an iterative reflective cycle is created (Fig. 2). Action is taken, reviewed and results in new action throughout the learning process with the aim to improve the learning level. Students' knowledge is constructed via reflexive approaches, while the adaptability and flexibility of the educational reality is maintained (Salto-Youth, 2012). Despite its open nature, the learning process is unfolded with constant focus on the project's goals.

Designing a process which promotes imagination is regarded as the greatest challenge for participatory action researchers (Wadsworth, 1998). The latter assume a largely facilitating role and may turn to external sources for technical assistance. Bearing in mind that the lack of students' engagement limits the effectiveness of an educational practice, discussions about the mutual interaction of researchers and participants towards knowledge production have arisen. Within such a framework, PAR promotes collaborative partnerships and bonding relationships between teachers and students (Kim, 2016).

Echoing Dewey (1859-1952), students' participation in project-based courses is essential condition for their learning. Via learning-by-doing processes, students enhance their active experimentation and participation in an experiential way (Kolb and Kolb, 2005). Identifying the way of learning, students follow a sequence of stages in accordance with Kolb's learning theory, depicted below (Fig. 3). They experience an activity, consciously reflect back on their experience, try to conceptualize what they observed through a theory or a model and test their model/theory for an upcoming experience. Thus, learners grasp an experience and consciously transform it to learning through reflection, which spans theoretical conceptualization and practical experience (Kohonen, 2012).

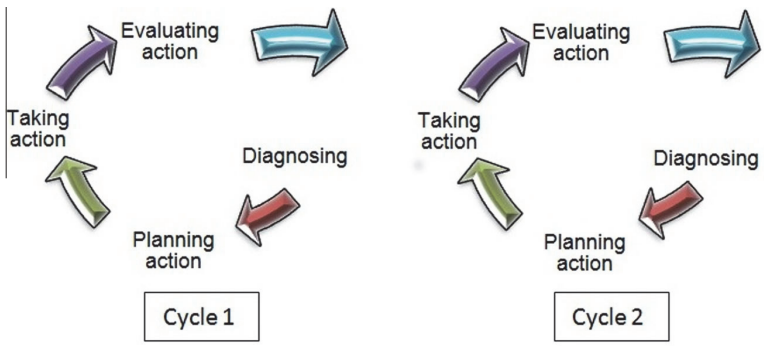


**Fig. 2.** Stages of PAR cycles (Adapted from Coghlan and Brannick, 2001, p. 19).

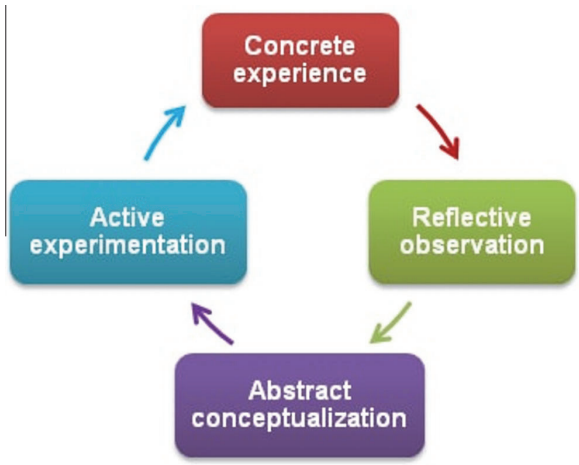


**Fig. 3.** The Kolb learning cycle (Adapted from Moobs, 2003).

## 4. Ecotourism, education and 3D printing: a case study

### *4.1. Educational scenario and approach*

The project took place in Zagori, a mountainous area in north-western Greece. In the context of a European Programme for education, training, youth and sport, 11 technical high-school students from Alcochete, a small municipality in Portugal, were received by the EcoMuseum Zagori. The latter is a social cooperative enterprise oriented towards the protection of the local natural and cultural heritage. Students participated in educational ecotourism activities and acquainted themselves with 3D printing technology under the coordination of the P2P Lab (http://www.p2plab.gr/en/), an independent media lab interested in free and open-source technologies and peer-to-peer practices. The educational project lasted 25 days and included the 3D printing of cultural heritage elements which were handed to persons with visual impairments so as to mobilize them towards ecotourism.

The first five days of the educational program involved discussions about the general framework of the procedure, the program flow, the desired objectives and students' expectations of the project. The latter were written by the students and posted on a wall, facilitating the conceptualization of the context and the final evaluation of the project. The functionality of experiential education and the orchestral role of the teacher in the educational process was explained (Papert, 1980). Moreover, the importance of non-formal education and the existence of activities promoting interaction and enthousiasm levels in teaching was highlighted.

An introduction to the following interrelated basic pillars of the project ensued:

- open hardware, which entails step-by-step explanatory manuals for the manufacturing of products,
- creative commons licenses, which enable the free distribution of creativity and knowledge,
- 3D printing, including 3D design programs, major materials used and 3D printed products,
- collaboration, as a crucial factor in educational projects.

Through this procedure, various discussions were triggered, which unveiled students' perception of the abovementioned concepts. Audiovisual and lecture-based exemplary topics took place by frequently switching from theory to practice. For example, students grasped the concept of open sharing knowledge systems by exploring Wikipedia, while they comprehended the idea of distributed production better by printing products. Furthermore, the power of collaboration was showcased by organizing a workshop in which different uses of a spoon were enumerated; at first each student individually, then merging the personal ideas into three-member groups and finally merging all together into the entire class, featuring the power of collective intelligence.

Regarding the allocation of the project's subtasks, there was an intent to form two working groups (involving five to six persons), both of which would handle the same tasks throughout the project. However, due to the high number of tasks and the openness of the educational procedure, smaller working teams were created. Each subteam included two to three persons and was planned to accomplish a part of the subtasks. The spontaneous segmentation of subgroups mainly by the students depended on their interests, skills and friendships and was indicative of the facilitating role of the educator.

During the whole project, students were free to undertake new tasks and work on various ideas via task rotations. To better coordinate the project, common cloud folders and a chatting group were created. At the beginning of each day a presentation of the advancements and new tasks of each team was taking place. Thus, required collaborations between the subteams could be planned and coordinated.

Another noteworthy element was the development of a blog (http://touchtosee.blogspot.gr/), where students could describe the educational project and share their experience. A team in charge of the blog was composed, which worked independently and turned to other subteams when necessary. For instance, the blog team announced the need for logo proposals, a task that was finally outsourced to students from other teams. The blog team also undertook the educational procedure with the aim to decide the blog name by calling their fellow students for brainstorming. Decisions were made through discussions, group collaboration and collective voting since conversation plays a vital role in learning (Papert, 1993). Considering the main goal of the project, the blog name "Touch to See" was born, as meaning that 3D printed objects could guide visitors with decreased vision and visualize the reality for them. Through the blog creation, students put the idea of sharing into practice by enabling the future iteration and improvement of the project.

Having investigated the requirements of the chosen 3D design program, students realized the necessity of making specific photo shootings. Therefore, an excursion for photo shooting local cultural and natural heritage elements was arranged. Particularly helpful for the visualization of the objects was a sketch of a local bridge made by two students (Fig. 4). During the editing stage of the pictures taken, students had to handle problems due to physical obstacles and shadows, which corresponded to holes and dark spots in the 3D model. In an attempt to deal with flaws of the pictures, students tinkered with the contrast and took some new pictures.

Having investigated appropriate software and attended tutorial videos for embossing images, students ended up to use "lithophanes" and printed the depicted image of a canyon (Fig. 5). Echoing Papert (1980), duration of technology use is a key factor for learners to become intellectually and emotionally involved. Having been introduced to 3D printers and design software programs, students had 25 days available to experiment and tinker with the technology and their solutions.

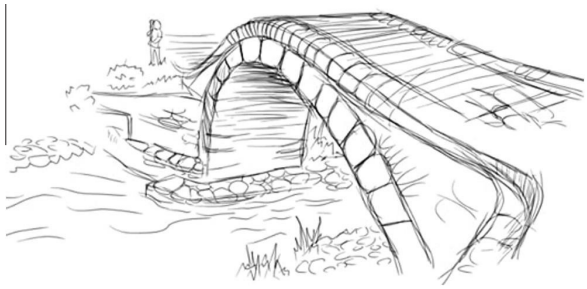

**Fig. 4.** Sketch of the bridge made by the students.

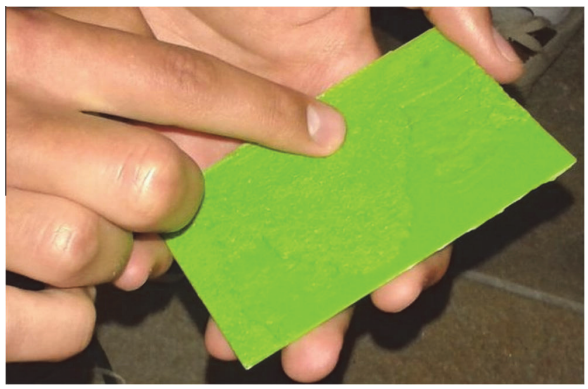

**Fig. 5.** A palpable lithophane of a local canyon printed by the students.

In the context of their common project, a 3D digital model of a local traditional stone bridge was manufactured by means of "123D Catch" program. In the meanwhile, another subteam offered to make a second design of the bridge through "Photoshop", so as to support the accomplishment of their task in case of the first model's failure. The sketches of the bridge were used for the second model to create a ground model with the landscape of Zagori, on which the first model, including the bridge, was placed. It should be also emphasized that we encountered difficulties in the creation of the 3D models via open-source programs due to their complex operation and their lack of usability. Thus, the proprietary program "123D Catch" was used, hampering the accurate implementation of our initial plan towards a completely open educational procedure.

During the project, learners were allowed to explore the research procedures by performing their own efforts, as it is believed that they learn better being in charge of their own learning processes (Freire, 2000; Papert, 1993). Students worked on appropriate adjustments and corrections of their 3D outputs through trial-and-error and turned to the teacher when needed. Thus, the facilitating role of the teacher was multi-faceted: to suggest cooperative activities among students, analyze their concerns, understandings and misconceptions, direct them towards their common goals and enhance further learning experiences.

Another crucial part of the educational process was the exploration of the blind or partially-sighted world. Role-playing games were organized to enable students to comprehend the reality faced by people with visual impairments (Fig. 6). Internet search and communication with the association of blind people of Ioannina city supplemented their deeper empathy of vision difficulties. In coordination with the aforementioned association, a visit of two persons with visual impairments was arranged in the midst of the project. The purpose of the meeting was twofold: first, students could break their possible prejudices about blindness and become aware of the reality faced by people having visual impairments through their interaction and, second, students could get first-hand preliminary feedback for their artifacts.

At the time the visitors arrived, the first pilot models had been printed and the stone bridge was at the 3D modeling stage. Persons with visual impairments inspired students and gave vital feedback with innovative ideas for practical modifications of the objects. Namely, the existence of a human or animal figure which could contribute to the scale perception of the depicted objects, the addition of felt so as to simulate the different materials and the existence of an orientation symbol were proposed. Most of the indicated modifications for the artifacts were applied by the students, such as the inclusion of a pig (part of the regional fauna) in the bridge model, demonstrating the scale of the bridge.

**Fig. 6.** Exploration of the blind or partially-sighted world by the students.

**Fig. 7.** Final artifact of the bridge.

Students' acquaintance with the Braille system was important for their communication with persons having visual impairments via the implementation of messages on the artifacts. A subteam was composed to translate and print texts to the Braille language. During the research, the subteam realized that the Braille language is not universal and started searching for web translators from English to Braille and from Greek to Braille, since the objects would be handed to Greek persons with visual impairments. Further improvements of the texts were achieved by considering several corrections proposed by the visitors.

Students came up with creative ideas, which derived from their dedication to the project and their interaction with persons having visual impairments. For instance, the existence of a natural stone material on the bridge model or the embodiment of water into the 3D printed bridge (possibly in a small bottle hidden inside the base of the bridge) which would give the sense of the water element, were nominated. Students developed a highly empathic perception of the way that persons with visual impairments perceive the environment. In their effort to substitute parts of the visual senses, students realized the importance of sensations and incorporated their understanding into the final artifacts in a creative and practical way (Fig. 7).

In the context of the experiential learning cycle, reflection was a significant tool to enable conscious learning at all stages of the educational process. Individual self-evaluations were made throughout the process by all students with the aim to recapitulate their previous tasks, check the overall schedule and plan their future steps. Lesson evaluations were taking place both at the end of each day and week, while ideas could be written on the "wall of ideas" anytime. A written idea, suggesting that each student could choose an object, print it and keep it as a memento, was found appealing by the majority. During the final evaluation of the project, students checked their initial expectations, recorded new ones that had emerged and valued the degree to which they had been satisfied.

### *4.2. Assessment of the educational process*

Both primary and secondary research were utilized to complete our qualitative research methodology. Our involvement into the development and the implementation of the educational process was complemented by questionnaires handed to

both students and educators. The reason why we also deploy objective criteria, such as questionnaires from insiders (students) and outsiders (Greek educators), is to avoid prejudiced conclusions stemming from our engagement in the procedure. Next we try to compare our personal experience with the results of the questionnaires.

Students' participation and commitment to the project was expressed as they frequently continued their work beyond the course timetable. Their dedication to the project was also evident through their focus, their high-level cooperation and their creative ideas during the entire educational process. Furthermore, a remarkable incident occurred when the instructor and the substitute instructor had to be absent for two days during the second week. The professor kept contact with the students through the group chat created for the project's coordination trying to organize a creative day. The prompt students' response including a picture of them working and greeting (Fig. 8) unveiled their strong self-motivation.

We acknowledged three basic motivational elements which may had led to the empowerment of learners' engagement in our educational project: the technological, the anthropogenic and the educational factor. Delving into the aforementioned components, 3D printing technologies embody the modularity, creativity and adaptability that education requires. The anthropogenic aspect entails the consideration of the familiarity with the local community together with our intrinsic tendency to empathize. The innovative educational practices of the project encompass alternations among different types of teaching (including formal, informal and non-formal learning techniques) which can trigger pluralistic types of learners.

Six months after the end of this project, we prepared anonymous online questionnaires of four closed-ended questions, which we then forwarded to the Portuguese students and analyzed for content. The reason why we sent the questionnaires after a span of six months is to test the conscious recollection of students' experience of the project. The questions concerned the significance of open-source technologies, their potential and the individual weight of the aforementioned motivational elements (see Appendix).

We received eight out of 11 students' answers, all of which converged towards the catalytic role of open-source technologies (versus proprietary ones) in the teaching process. Students also agreed that they learned more through open-source technology, while one student answered that the use of open-source or closed-source technologies makes no difference in the obtained knowledge. All students except one used open-source technology at least once after the project's end. Among


**Fig. 8.** Students' engagement in the project during the absence of the professors.

the aforesaid motivational factors, the majority of students (six out of eight) replied that the 3D printing experience springs first to their mind. One student answered that he vividly recalls the meeting with the persons having visual impairments, while another mostly remembers the educational activities.

The effectiveness of the educational scenario was also evaluated by Greek educators of varying disciplines with the aim to communicate and scale our educational approach, so as more teachers could benefit in the future. A workshop was held in Athens, Greece, on the 25th of January 2017, in the context of an innovative program to transform education called Big Bang Academy. At a first stage, the "Ecotourism, education and 3D printing" project was presented to 38 educators, who subsequently had to create, present and reflect their own educational scenario. Based on the three basic motivational elements, teachers proposed creative ideas, such as a 3D printed model of a museum monument visited by the students.

After the completion of the workshop, each teacher was asked to complete a post-workshop online survey with five closed-ended questions. The first two questions pertained to the educators' previous experience and future plans for using open-source technologies. Half of them had already used open-source technologies in their teaching, while a greater portion was eager to use them in the future. In more detail, 57 percent of the teachers were confident enough to employ such technologies, 29 percent supported that they will use them, while the rest (14 percent) were uncertain about whether they will connect such technologies with their curriculum.

Although a significant portion (72 percent) of the educators who hadn't used open-source technologies before the workshop were impelled to do it in the future, there were educators who claimed that they won't use them. Possible reasons for their reluctance to use technological objects may pertain to their current unclear definition and newly-emerged concept. In addition, considering the contemporary socio-economic crisis in Greece, educational systems probably face difficulties in affording technological equipment, even an open-source, low-cost 3D printer.

Regarding the compatibility of the educational procedure with open-source and closed-source technologies, half of the teachers claimed that education is equally compatible with both types of technology. 43 percent positively rated the compatibility of open-source technology with education, while 7 percent assumed that proprietary technologies are more compatible with the educational process. Moreover, 86 percent deem open-source technologies as more suitable for the empowerment of students' critical thinking than the closed-source ones, while the rest (14 percent) view both types of technology as equivalent. The majority of the responses to the latter question accords with the related literature references, which reckon that open-source technologies advance users' critical thinking (Czerkawski, 2010, p. 215; Pellas, 2015).

Finally, the question regarding the students' motivational factors was also posed to the educators to enable the comparison between students' and educators' views. According to the educators, the employment of non-formal education in the teaching process serves more as stimulation for students to participate in the learning process (82 percent) than the utilization of technological means or the anthropogenic factor (9 percent). In comparison with students' responses to the questionnaires, Greek teachers valued the educational element of non-formal learning as the most important factor for enhancing students' motivation, while students strongly endorsed the technological factor.

## 5. Conclusions

The potential of new forms of learning was explored through a case study analyzed in this paper. Towards this goal, we used Kolb's experiential learning cycle and PAR approaches. In an effort to drift away from the notion that schools monopolize knowledge, we investigated alternative ways of fostering meaningful communication and collaboration through open educational practices. Rapid social, economic and political developments require transformative shifts in the educational structure of the contemporary interconnected world (Morgan, 2013). Aiming at the global accessibility of knowledge and the enhanced effectiveness of students' educational attainment, the use of open-source technologies in educational programs has been proposed.

Our 25-day long educational experiment shed light on the potential of open-source technologies as tools for creating and disseminating knowledge and communication. Building upon previous work towards the same direction (Kostakis et al., 2015), our educational scenario served a twofold aim: first, it confirmed the great potential of 3D printing as a motivational learning tool and, second, it added the aspect of 3D printing as a means for meaningful communication among people with and without visual impairments.

Based on the concepts of constructionism in a non-formal educational context, we developed our training model. Students engaged in hands-on explorations and manufactured models of natural and cultural heritage elements of the Zagori region. Via collaborative procedures, they familiarized themselves with project-based problem solving. Among others, they learned how to create three-dimensional models of natural objects, use a 3D printer and create a blog.

The created artifacts were handed to a group of people with visual impairments so as to spur communication with students, empower the educational process and improve the final result. The ultimate goal of the objects was to help persons with visual impairments to experience geocultural tourism. Among the three explored motivational factors for students' participation (technological, anthropogenic and educational), the majority of students claimed that the technological element intrigued them the most. On the other hand, Greek teachers considered the educational component as the most important.

The application of open-source technologies towards flexible and meaningful educational settings is challenging. In the context of contemporary schools, the required time to organize similar educational programs is usually hard to find. The willingness to deal with a considerable amount of uncertainty related to the use of such technologies has also to be

considered. Moreover, the familiarization of both teachers and students with open-source technologies is required as well as their keeping up with the technological advances.

Through internet-based information mechanism, experimentation and discussions, we attempted to transform the aforementioned obstacles of open-source technologies into tools for reaping additional benefits of the educational procedure. Of course, wider questions around the implementation of technologies in education, the educational potential of open-source technologies and the contribution of technology to contemporary school problems should be investigated. We hope to provide food for thought and guidance contributing to the development of proper teaching models geared towards learners' inclinations and needs, so as the education of the future could be prudently constructed.

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**Appendix**

| Descriptive table of students' answers | |
|---|---|
| 1. Do you think that the use of open-source technologies, instead of closed-source ones, made your work: | |
| Easier | 100% |
| More difficult | 0% |
| Neither easier nor more difficult | 0% |
| 2. Do you think that the use of open-source technologies, instead of closed-source ones, made you acquire: | |
| The same level of knowledge | 12,5% |
| More knowledge | 87,5% |
| Less knowledge | 0% |
| 3. Which is the first thing you recall about the educational program? | |
| Non-formal educational elements | 12,5% |
| The interaction with people having visual impairment | 12,5% |
| 3D printing | 75% |
| 4. Have you ever used open-source technologies in any way after the educational program? | |
| No | 14,29% |
| Yes | 85,71% |

| Descriptive table of educators' answers | | | |
|---|---|---|---|
| 1. Do you think that the educational process is more compatible with: | | | |
| Both open-source and closed-source technologies | | | 50% |
| Open-source technologies | | | 42,86% |
| Closed-source technologies | | | 7,14% |
| 2. Which type of technologies do you think that enhances more students' critical thinking skills? | | | |
| Both types equally | | | 14,29% |
| Open-source technologies | | | 85,71% |
| Closed-source technologies | | | 0% |
| 3. How possible is it for you to use open-source technologies in a future lesson? | | | |
| Very | | | 28,57% |
| Enough | | | 57,14% |
| Little | | | 14,29% |
| 4. Had you ever used open-source technologies during your teaching before you participated in the Big Bang education workshop? | | | |
| No | | | 50% |
| Yes | | | 50% |
| 5. Which of the following elements do you believe that motivates students in an educational program? Choose a number from 1 (most important) to 3 (least important). | | | |
| | 1 | 2 | 3 |

| | | | |
|---|---|---|---|
| The anthropogenic factor | 9,09% | 35,71% | 38,46% |
| The technological factor | 9,09% | 50% | 38,46% |
| The educational (non-formal) factor | 81,82% | 14,29% | 23,08% |

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**Publication II**

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*Article*

The Sociological Review Monographs

# The ecosystem of commons-based peer production and its transformative dynamics

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## Abstract

This essay discusses peer-to-peer social dynamics and the relevant technological infrastructures that enable new modes of production. Commons-based peer production is presented as an alternative to the profit-driven peer-to-peer production models of the digital economy. The latter models utilize the peer-to-peer dynamics to harness social creativity, collaboration and information sharing. The created value is then captured and valorized towards profit maximization. This essay argues that there are possibilities for moving away from such extractive models to more generative ones. Commons-based peer production seems to encapsulate both social and environmental sustainability, and thus has the potential to influence such a transition. As commons-based peer production cannot yet reproduce itself outside of a mutual dependence on capitalism, it risks being subordinated. To counter this, a commons-oriented solid and protective ecosystem is needed to fully unleash the creative capabilities of commons-based peer production.

## Keywords

commons, Enspiral, Farm Hack, institutions, P2P Foundation, peer production, Sensorica

## Introduction

Within the context of today's information-based digital economy, peer-to-peer (P2P) is related to an emerging set of dynamics that influences production and exchange. This essay attributes a series of qualities/properties to P2P: it is realized as a type of social

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relations in human networks, described as an array of technological infrastructures, and promoted as a new mode of production.

According to this approach, P2P, first as a relational dynamic of human interaction, seems to invoke ideally a model in which humans act or have the potential to act as equals. In practice, this means that they may organize themselves in decentralized and non-hierarchical networks, with the aim of communicating, collaborating, creating and exchanging value. Such interactional potential pertaining to P2P is evolving as information and communication technologies are becoming accessible on a universal basis. In a P2P network, peers are interconnected nodes holding interchangeable roles, either that of the file server or that of the client, both of which can share resources via the Internet without the use of a centralized administrative system. In recognition of its significant position within the technological spectrum, P2P has been used more widely as an umbrella term to describe everything from YouTube, a fully commercial and closed platform, to open networks using the BitTorrent protocol (Lund & Venäläinen, 2016).

Despite the absence of a centralized administrative system, P2P does not always imply a decentralized structure, fairness, or any kind of common property among participants. As any type of new technology, P2P technologies cannot be seen as something good, bad, or neutral. Following Feenberg (2012), technology is a terrain of struggle, in which different interests and values strive for supremacy. Facebook, Bitcoin, Airbnb, Wikipedia and GNU/Linux are some well-known examples that use P2P socio-technological infrastructures, but in such a different manner: in the digital economy there exist P2P models of production that operate in an extractive way as well as P2P models that have more generative orientations. Within a semantic comparison between these two polar extremes, extractive as a notion refers to any activity that depletes a source with no provision for replenishment, whereas generative implies propagation, reproduction and enrichment of a source. The extractive models utilize the P2P dynamics to harness social creativity, collaboration and information sharing towards profit maximization, thus carrying out a form of surplus value extraction. The aforementioned can be illustrated by the case of Facebook. As with most social media, Facebook is offered as a free online service, where information exchange among its users creates value that is valorized to such an extent that it becomes a commodity with a market price. 'Facebook is not actually selling what we produce on social media, which is about sharing "use value" with our peers, but what they are selling is derived from our sharing, i.e. data about our likes and interests' (Bauwens & Niaros, 2017, p. 10). According to Arvidsson et al. (2016), the 'rent' that Facebook can extract per user is about US$2 a year.

This essay argues that there are possibilities for moving from such extractive models to more generative ones using P2P socio-technological dynamics. In that direction, we here focus on those more generative and non-proprietary P2P projects and networks, where shared resources are produced. Those projects exemplify what Benkler and Nissenbaum (2006) have called 'commons-based peer production' (CBPP), some notable examples of which are Wikipedia, GNU/Linux and WordPress. As opposed to the extractive P2P models like Uber and Airbnb, CBPP does not view peers merely as individual nodes able to directly communicate with each other and create contracts, but as collective ones able to shape a community that produces, consumes and manages a common property as well. This common property pertains to information such as

**Table 1.** The three institutions of five CBPP ecosystems.

| | | | | | |
|---|---|---|---|---|---|
| *Productive community* | Linux | Mozilla | GNU | Wikipedia | WordPress |
| *Entrepreneurial coalition* | e.g. Linux Professional Institute, Canonical | e.g. Mozilla corporation | e.g. Red Hat, Endless, SUSE | e.g. Wikia company | e.g. Automatic company |
| *For-benefit association* | Linux Foundation | Mozilla Foundation | Free Software Foundation | Wikimedia Foundation | Wordpress Foundation |

knowledge, code and design. Benkler (2014) referred to those common entities as the 'new commons'.

In essence, the aim of this essay is to provide a bird's-eye view of the ecosystem of CBPP, that is, based on those 'new commons', and outline its transformative, yet tentative dynamics. The concept is introduced in the next section, then, in the third section, the ecosystem of CBPP is presented through four short case studies. Based on the analysis of the CBPP ecosystem, the fourth section addresses how small group dynamics could now be applied and be advocated at the global level, and lastly, the fifth section summarizes the themes of this essay while concluding with suggestions for future research and action.

## The ecosystem of commons-based peer production

This essay discusses the evolution of a CBPP ecosystem as generally consisting of three institutions: the productive community; the commons-oriented entrepreneurial coalition(s); and the for-benefit association. Each one has a different composition and facilitates different stages of CBPP, yet together, those three institutions are interconnected towards achieving the integrity of a CBPP project.

Our description of the CBPP ecosystem cannot be all-inclusive, for each ecosystem is unique, nor do we want to claim that there is a deterministic evolution of all CBPP projects that in maturity reaches the trinity of institutions. It cannot be definitive either, since we are dealing with a rapidly evolving mode of production (Bauwens, Kostakis, & Pazaitis, in press). For example, there are CBPP projects in which an institution like the for-benefit association does not exist, or in which only the productive community can be identified. In short, the aim of this essay is to offer an overview of the expanding universe of CBPP. Table 1 outlines the existence of the three aforementioned types of institutions, as found in five of the older and most well-known CBPP ecosystems. Each of these institutions contributes differently to the internal function of the particular ecosystem as well as the latter's external affairs with the market and the state.

A striking feature of the first institution-component of CBPP, the productive community, is that it comprises all the contributors to a project, not the 'direct' contributors alone. This means the end users of CBPP products can also be part of this community; this 'indirect' contribution pertains to the detection of bugs, the suggestion of modifications and the request of new functionalities, for example, thus forming a feedback loop that leads to the improvement of the CBPP products. As an additional aspect of

this indirect contribution, emerges the participation of end users in forums, forming to a certain extent the way that the initiative is developed. Under those circumstances, the product can thus be constantly upgraded. Bauwens (2005) and Benkler (2006) clearly acknowledge that synergetic cooperation among participants (direct contributors) and users (indirect contributors) is an immanent characteristic of CBPP. Analysing in depth the CBPP concept with a special focus on the productive community, it becomes evident that participation needs no permission, as the threshold of the involvement is as low as possible.

Moving on to CBPP practices, we can identify the use of P2P platforms facilitating synchronous and asynchronous collaboration (De Filippi, 2015), in which everyone can see the manifestations of the work of others, and can therefore adapt to the needs of the system as a whole. The key motivating factor for contributing to a CBPP project is not monetary compensation, but in most cases, the motivation is the creation of something mutually beneficial (Benkler, 2006, 2011). Other motivations may be the need to learn, belong and communicate; a form of social value – emotional value – that is mostly generated outside the market economy and cannot therefore be assessed through conventional market mechanisms (De Filippi, 2015). Concerning the need to belong and communicate, Arvidsson et al. (2016), in their three-year ethnographic research on CBPP communities, claim that CBPP digital communities and similarly most physically rooted communities are characterized by a low density of interaction and socialization and that, apart from the constituent ones, most other members participate only sporadically. As a last note, Arvidsson et al. (2016) observe that the participants in a CBPP project may gain reputation (a sort of 'proto-currency') that in the CBPP context can be thought of as a kind of social capital and a valid non-shared asset, that gives some members authority and access to scarce goods within communities or grants them decision making on behalf of those communities.

The second discernible institution is the commons-oriented entrepreneurial coalition, which attempts to produce either profits or livelihoods by creating added value for the market, based on the common resources (Bauwens et al., in press). With this in mind, a substantial number of people who contribute to CBPP projects want to be able to make a living out of their CBPP activities (Arvidsson et al., 2016). In the best of cases, the community of entrepreneurs coincides with the productive community. Provided that something like this happens, the contributors may through their activities make a livelihood, while producing the commons, and reinvest surplus in their own well-being and the overall commons system they co-produce (Bauwens et al., in press).

The third institution is the for-benefit association. The for-benefit association can be seen as the governance institution of a CBPP project, which supports the infrastructure of cooperation. Despite for-benefit associations often taking the form of non-profits, they do not command and direct the CBPP process itself. Conversely, for-benefit associations operate from a point of view of abundance. They recognize problems and issues, but believe that there are enough contributors that desire to assist in solving these issues. Hence, they maintain an infrastructure of cooperation, that allows contributive communities and entrepreneurial coalitions to engage in CBPP processes vital for solving those issues. Not only do they actively protect these commons through licences, but may also help manage conflicts between participants and stakeholders, fundraise, and assist in the

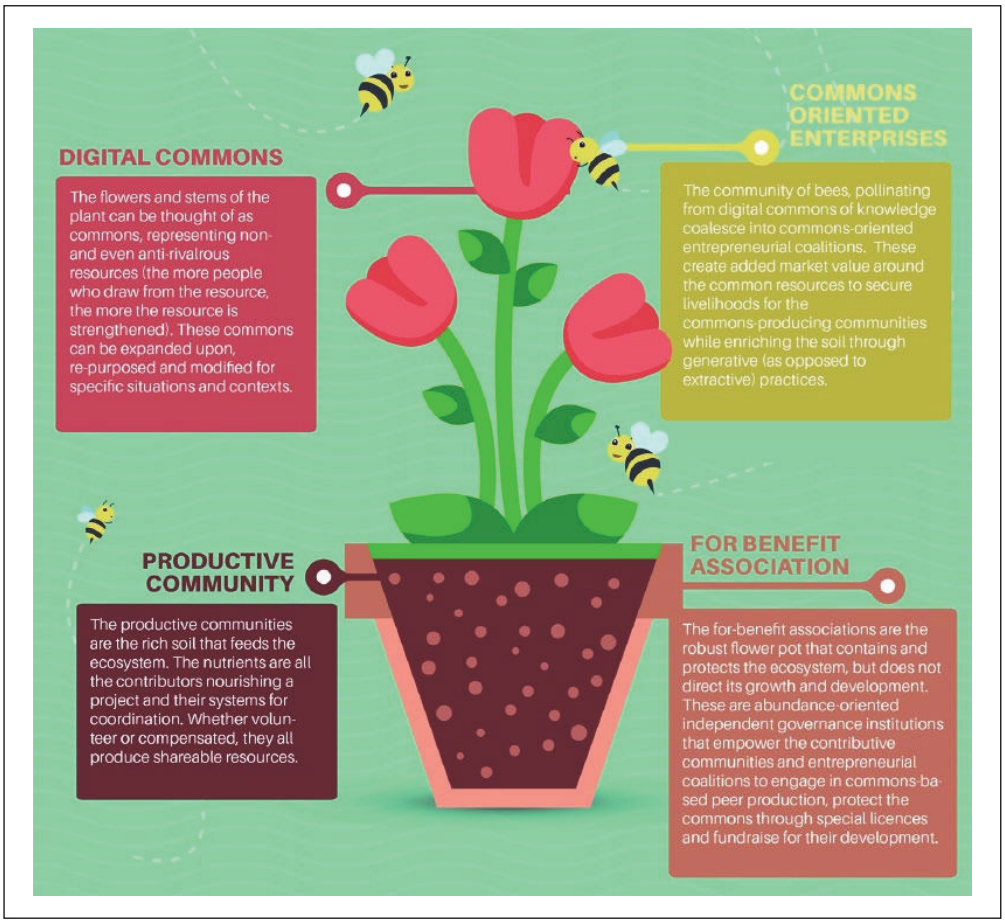


**Figure 1.** The new ecosystem of value creation.
*Source*: Bauwens, Kostakis, Troncoso, and Utratel (2017, p. 16).

general capacity building necessary for the commons in particular fields of activity (for example, through education or certification) (Bauwens et al., in press).

Given the above, a CBPP ecosystem can be visualized as a plant, as illustrated in Figure 1. The flowers and the stems of the plant can be thought of as the digital commons representing non-rival resources, whereas the soil in which the plant is rooted as the productive communities. These enrich the soil with nutrients through their contributions, thus nourishing the flowers and the stems: the digital commons. The flower pot that contains the soil and protects the plant ecosystem can be thought of as the for-benefit associations. Lastly, the bees that pollinate the plant, the digital commons, resemble the commons-oriented entrepreneurial coalitions. Those bees create added market value around the common resources to secure livelihoods for the commons-producing communities, thus enriching the soil through generative practices.

In the remainder of this essay, we will briefly present four case studies that depict four emerging ecosystems of CBPP, observed via the scenario of the trinity of institutions that fortifies them.

## Short case studies of four emerging ecosystems

In addition to the well-documented ecosystems of free and open-source software projects (see Benkler, 2006; Dafermos, 2012; Harhoff & Lakhani, 2016; Mateos-Garcia & Steinmueller, 2008; Von Hippel, 2016) and a three-year ethnographic study on CBPP communities (Arvidsson et al., 2016), the cases of Enspiral, Sensorica, Farm Hack and the P2P Foundation offer a broader perspective on the rich tapestry of CBPP ecosystems. Apart from observing the existence of the three institutions in each of those cases, which strengthens our argument, they have been chosen because they depict an 'ecosystem of ecosystems', that is to say, a bigger picture of the CBPP universe. Here inspiration is a keyword – a concept that functions to prompt these three institutions to imitate one another, share value beliefs and interact for the promotion and augmentation of CBPP initiatives. Looking back, we can see[1] how, for instance, Loomio, a member of Enspiral, in the beginning consulted the P2P Foundation on issues of organization and the structure of CBPP initiatives and, quite possibly, was consequently inspired. The P2P Foundation, in turn, as a network monitoring and promoting actions geared towards a transition to a commons-based society, was inspired by Loomio, Enspiral and other initiatives, which in fact fuel its research field and help it continue its research and advocacy, as is the case with the present study. So, the P2P Foundation through its institutions, produces commons, which are used by other initiatives and vice versa. The authors, as core members of the P2P Foundation, present a view that comes from the inside through participatory case study, acknowledging the possibility for biased interpretation of the results. On the other hand, as insiders, we had the chance to experience the complex interconnections between the institutions and different initiatives.

The above cases, although younger than those presented in Table 1, exhibit characteristics of developing – to a certain extent – the three types of institutions described as well.

### *Enspiral*[2]

In order to be able to elaborate our argument regarding CBPP ecosystems, a description, first, of the case of Enspiral is in order. Within an array of meanings, first and foremost Enspiral is a network of professionals and companies that are 'working on stuff that matters', i.e. socially oriented projects (Enspiral, 2017a). Enspiral corresponds to a multifaceted network of members – either companies or individuals – who, amid a diversity of skills, foci and working methods, manage to retain an operative equilibrium under a set of shared values and a passion for positive social impact. The notion of social impact is reflected in what Vanclay (2003) refers to as a change-facilitator: changes that refer to one or more of the following: (1) people's way of life including work and interaction; (2) culture, like people's beliefs and values; (3) community, its cohesion and stability; (4) political systems and people's participation in their democratization; (5) environment; (6) people's health and well-being; (7) people's personal and property rights; (8) their fears and aspirations. Enspiral is a broad community of diverse professionals (productive community), including developers, legal and financial experts, and these members pool their skills and creative energy to produce a commons of knowledge and software, while collaborating

online, through digital tools, and offline, in a shared co-working space (Enspiral, 2015). A web of business ventures called the Enspiral Ventures, operating around those commons, offer open-source tools and services, that enable creative communities to address certain challenges related to democratic governance and the digital age. Realizing ventures as entrepreneurial coalitions, it comes as no surprise that members of the community are free to choose when to join or leave and how to contribute to the network.

The picture is completed with the Enspiral Foundation (for-benefit association), a cooperatively governed non-profit, that facilitates collaboration and supports, as custodian, the network as a whole. All assets held by the Enspiral Foundation are managed collectively by its members. The Foundation, as the 'root node' of the network (Vial, 2012), is the entity with which all professionals and companies have a formal relationship. It maintains the network's infrastructure, holds the collective property and guarantees its culture and mission. Finally, its legal form is a limited liability company (Ltd) with a charitable constitution, though not officially registered as a charity.

At the time of writing, there are about 300 people contributing to one or several of the 15 business ventures that are linked to the Enspiral Foundation (Enspiral, 2017b; NZ Ministry of Business, Innovation and Employment, 2016). These include Scoop, Loomio and Rabid. To begin with, Scoop is a participatory model for news publishing, New Zealand's largest independent news source and, specifically on the Internet, a place for publishing 'what was really said' (Enspiral, 2017b). Continuing with Loomio, the grounds for its establishment as an open-source platform for participatory decision making were initially laid by a team of activists from the local Occupy movement in Wellington, New Zealand, who cooperated with Enspiral to create a tool to help self-organized communities make decisions without centralized coordination (Schneider, 2016). The last one, Rabid, is a company offering expert services on web development, which supports the open-source community.

The non-profit nature of the aforementioned Ventures (Scoop, Loomio and Rabid) is further revealed by their generation and distribution of revenue: starting by offering their software solutions and services to clients, they eventually distribute this revenue back to the contributors, yet a part of it (usually 20%) is fed into the Foundation in the form of voluntary financial contributions. Each Venture defines how to contribute to the network, financially and otherwise; this free rein does not put up barriers to collective activities within the Foundation – quite the opposite: Ventures are invited from the Foundation to participate in the collaborative funding process and decide how the discretionary portion of their contribution will be allocated. The remaining collective funds can be requested as needed for a project, by any member. A digital application, Cobudget, developed as an Enspiral solution, is used in this collaborative funding process by Enspiral itself, but also by various groups, institutions and ventures. This exemplifies the development of new tools in practice, that promote and unleash more democratic ways of money flows and project support. Such tools enhance the 'pollination' of the commons community, reinvesting in a horizontal way value that can be used by the commons-based productive community. Moreover, Loomio offers its software solutions for free to commons-based initiatives (while not doing the same for market-based initiatives), exemplifying in the best possible way how an initiative, supported by its for-benefit association, can support itself and other forms belonging to its ecosystem.

The Enspiral culture is dedicated to the creation of value for the society, rather than for shareholders. To put it another way, it is oriented towards the common good and is proactively creating the conditions to serve this purpose. This approach on value is more clearly illustrated by one of Enspiral key principles, the so-called 'capped returns'. The general idea is to introduce an upper limit (a 'cap') on the total returns which investors may receive on the equity of a business. For this, the shares issued by a company are coupled by a matching call option, which would require the repurchase of the shares by the shareholders at an agreed price ceiling. Once all shares have been cashed by the company, it is then free to reinvest all future profits into its social mission. Through this mechanism, external and potentially extractive capital is disciplined to become 'cooperative capital'.

### *Sensorica*

The case of Sensorica also illustrates the CBPP ecosystem trinity. Sensorica is an open-source hardware business which, on an operational level, is regarded and run as a collaborative network, devoted to the design and deployment of fibre optic-based sensors and sense-making systems (Sensorica, 2017a). Of its many services, the most prominent of all is an open digital platform where individuals of any type of skill or expertise (e.g. engineers, researchers, developers or lawyers) can interact, as well as organizations from the business and public sector, and civil society. Transparency is a key characteristic of Sensorica's culture: everyone can observe the designs/documentation of each of Sensorica's products, regardless of the stage of construction. In this way, through what is characterized as a 'capturing mechanism' (Sensorica, 2017a), members are able, on the one hand, to provide work and resources, whenever and wherever needed, and on the other, take the lead at any stage of the value chain – from product development to distribution. However, the fruition of all products is not definitive; the construction process of those products that do not sustain the interest of members, and thus are not perceived as valuable by others, will end naturally (Turgeon, Thai, & Epuran, 2014).

At this point, special mention should be made of the productive community, which lies at the heart of Sensorica's network. The productive community is identified with the creation of projects in the form of open ventures. The way these open ventures acquire the needed resources is through processes like crowdsourcing (time-based contributions) and crowdfunding (financial and material contributions). The commons co-created by the productive community can be commercialized, but they always remain legally secured under Creative Commons Licences (Sensorica, 2017a). The members of the productive community, however, are not allowed to complete transactions with the market. For this reason, they have to pass through Sensorica's designated 'exchange firm'. This exchange firm can be thought of as Sensorica's Foundation, an association responsible for: (1) certifying Sensorica genuine products by stamping every product with Sensorica's logo; (2) preventing concentration of power within the network; (3) ensuring that those products and services meet the required quality and ethical standards; and (4) nurturing the Sensorica brand (Turgeon et al., 2014). This exchange firm stands between the market and the productive community, as it executes transactions and redistributes the revenue to the contributors. On the other side, all the agents

participating in the network are affiliated with this for-benefit association, which, inter alia, is responsible for the management of the common infrastructure and resources, and has custody of the assets, and of the network. This set-up is based on a 'non-dominium' agreement. By definition, 'non-dominium' refers to the prohibition of one or more agents having any form of control over the shared resources. Such a regime exemplifies the principal characteristics of Sensorica: its structure its dynamic and highly adaptable and it strives to combine open, large-scale collaboration with fair distribution of the co-created value. Therefore, we can see that Sensorica not only supports the infrastructure of cooperation, but moreover, experiments in new ways that will help the community accomplish its mission and realize its values.

All revenue following the commercialization of the community's products is fed back into the network, and, in particular, to the people that have been involved. For this, Sensorica has developed a system that facilitates value accounting and resource management in the network (Sensorica, 2017b). This system records and determines every member's input in each project, and redistributes revenue in proportion to each contribution, but also detects and returns revenue to possible contributors from other projects (e.g. pieces of code used from other open-source projects), by using the so-called Network Resource Planning – Value Accounting System (NRP-VAS) (Sensorica, 2017b). Reflecting Zimmermann's criticism (2015), this value accounting system, a 'surveillance machine', which measures and counts all sorts of contributions people make to a project, may undermine the intrinsic motivation which appears as a driver in the whole open-source world. The second attribute of this system, that of resource manager, refers to the tracking of all activities in the network in terms of the relevant resources which are either used or generated by a project – given that one project's output can be another project's input – which is done via the so-called Open Value Network (OVN) (Sensorica, 2017b). This refined system of attribution of values confirms Arvidsson et al.'s (2016) findings, according to which, the majority of the CBPP initiatives that were studied in their research expressed a wish and a need for more structured methods in assessing participation and work offered in the community, in order to have a better way of allocating reputation.

One of the most successful Sensorica projects is Mosquito, which is a force/displacement sensor device with numerous applications in biotechnology, which has been commercialized by a sensor company for scientific, educational, industrial and medical applications.

To summarize, Sensorica is part commons-based community and part entrepreneurial entity. On the one hand, individuals and organizations (productive community) pool resources and organize themselves around projects that produce open-source hardware technological solutions. On the other hand, a group of independent business entities (entrepreneurial coalitions), often launched by the community, introduces the innovative solutions to the market, through Sensorica's exchange firm (for-benefit association) (Bauwens et al., in press). Sensorica's case does not appear to have a separate entity with the role of for-benefit association, thus we can consider Sensorica itself as such. What is evident, and is best depicted in Sensorica's business model (Figure 2), is the productive community and the entrepreneurial coalition, which form Sensorica's commons-based ecosystem.

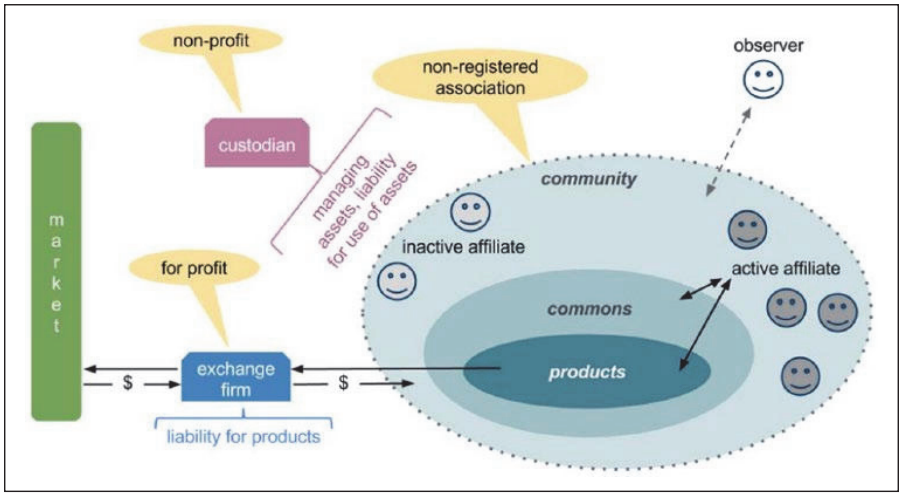


**Figure 2.** Transactions between Sensorica, active affiliates and inactive affiliates in the Sensorica business model.
*Source*: Sensorica (2017b, p. 4).

## *Farm Hack*

On our route to comprehending the concept of CBPP ecosystems, we now deal with a case study that focuses on the primary sector, that of Farm Hack. First we should focus on its internal structure, starting with its established network of agents. Farm Hack is an open-source community which functions as a 'glue', bringing together farmers, engineers, roboticists, designers, architects, fabricators, tinkerers, programmers, hackers, in order to build and modify tools and machinery with the aim of moving towards sustainable farming through global design and local manufacturing (Farm Hack, 2016). The hub of Farm Hack is framed by important nodes. First there is its digital platform, a platform for community-based sharing and collaborative research, through which the productive community shares designs, know-how and ideas. For example, through its website, Farm Hack provides an extensive guide on how to organize and run events, and offers communication support, as long as activities are in line with the community's basic principles (Giotitsas & Ramos, 2017). Therefore, Farm Hack performs as a for-benefit association supporting individuals or groups that coexist under the same denominator, namely their shared passion regarding open-source technologies and agrarian machinery. Other than that, Farm Hack also organizes events for the development of tools; these events can be open or more focused, targeted at disseminating technical knowledge or at specific problem solving, respectively (Giotitsas & Ramos, 2017).

Farm Hack's dynamic trajectory can be portrayed by what its online tool platform features, as well as the size of its community: the platform offers more than 500 tools and pieces of machinery, while the community is followed by around 6000 members from all over the world. Tools include both open-source software and hardware. Among these is FarmOS, an open-source web-based application for farm management, planning and record keeping (FarmOS, 2017). Another example featured on the platform,

among the agricultural hardware, is the Cover Crop Roller. This tool is designed for such purposes as the increase of organic matter in soil, the retention of moisture and the reduction of herbicide use. All tools and designs produced by the Farm Hack community are made available under Creative Commons Licences, and may be accessed by everyone (Farm Hack, 2016).

A non-profit (for-benefit) association monitors, maintains and improves the platform according to the ethos and desires of the community. At the same time, some of the most active inventors/farmers contributing to the platform invest a considerable amount of time and resources to developing prototype tools. The community enables them to engage in entrepreneurial activity (entrepreneurial coalitions) in order to continue enriching the community commons and support themselves in the process (Bauwens et al., in press). These inventors/farmers are able to decide upon the business model they will adopt, as long as the basic principle of openness is maintained. These inventors/farmers may manufacture and sell the tools or components. They may also sell partially assembled kits, or simply conduct workshops to teach other farmers how to build their own tools. This ongoing process is not without its detractors, a major point of discussion as well, within the community (Giotitsas & Ramos, 2017). Yet, the creation of sustainable commercial activity benefiting from, and at the same time empowering the community is clearly desired. Therefore, the Farm Hack community empowers people and groups to share and develop knowledge, and to elaborate ways to create added value for the market, enhancing and supporting a diverse creative community (Bauwens et al., in press).

### *P2P Foundation*[3]

The last of our four case studies of CBPP ecosystems is the P2P Foundation. The P2P Foundation (P2PF) and its research branch, P2P Lab, is a global network that consists of researchers and activists monitoring and promoting activity geared towards a transition to a commons-based society. Its ultimate aim is the construction of a knowledge commons ecosystem for the growing P2P/commons movement (P2P Foundation, 2017a). At the time of writing, the P2PF's dynamic ecosystem consists of a global core team and few regional nodes. Around them, operate the affiliates and the supporters that together complete the network. Their coordinated and joint action constitutes a productive community that documents, researches and promotes P2P alternatives and the commons, while its internal structure resembles the characteristics of our trinity of institutions.

The core team consists of people who work for the P2PF. Focusing on the microcosm of the P2PF, its concept and direction serve to safeguard the overall vision, and is mainly focused on the advocacy of the commons and the peer production through policy proposals. Within its policy framework, certain activities are manifest: P2PF supports two blogs and several wikis, releases reports and organizes and participates in activities, so that people can communicate ideas or discuss topics of common interest (P2P Foundation, 2017b).

The P2P Lab is a media lab dedicated to interdisciplinary research on free and open-source technologies and P2P practices (P2P Lab, 2017) that nurture the Foundation's vision. The P2P Lab develops its structure and way of working according to the characteristics of the fields it studies, as it considers itself part of them. Therefore, peer-to-peer

practices are common between its members, like sharing workload, money, infrastructure and time, and implementing do-ocracy and meritocracy in the decision-making processes. Moreover, the P2P Lab participates as a member or consultant in various initiatives related to the commons, with the aim of being a living cell in the commons-based ecosystem, supporting initiatives, helping knowledge transfer and communicating research outcomes.

These two entities can be perceived, respectively, as the for-benefit association (P2PF) and the entrepreneurial coalition (P2P Lab) of the ecosystem. The P2PF is a non-for profit organization that gets both structural and project-based funding. The P2P Lab has research projects funded through various sources, including the European Union, university and institutional funds. People that work in these two organizations create livelihoods through those funds, in order to research and strengthen the CBPP ecosystem. Around the P2PF exist several regional nodes, like the P2PF France and the P2PF Korea, which support the advocacy of the commons, while also supported by the P2PF in their projects. These regional nodes can be thought of as the local for-benefit associations (even though at an early stage, at present, and therefore open to future modification), which try to support CBPP ecosystems in different areas. The P2PF, the P2P Lab and the regional nodes constitute the 'active members' of the network.

Around the circumference of the core teams and its regional nodes are found the affiliates: individuals, teams or organizations that are free to self-organize their time and work, and have a high level of engagement with the P2PF, P2P Lab or the regional nodes. Such an engagement can take various forms, like contributing to the P2PF blog, taking part in reports and sustaining the P2PF's digital infrastructures. A point worth mentioning is that the affiliates can be supported by the P2PF, but do not receive funds through it. On the periphery we can identify the supporters of the network: nodes that may be thought of as all those individuals, teams or organizations that informally engage in social media, and/or support and promote the work or events of the P2PF and P2P Lab.

Finally, a P2PF Stakeholder Advisory Board that consists, mainly, of academics and researchers of the commons was recently created. This board has the role of advisor and of conflict resolution, and therefore can be seen as a for-benefit association.

To close the discussion, it is important to mention that Enspiral, Sensorica, Farm Hack and the P2PF fit within the parameters of our description of the ecosystem of commons-based peer production, like many free and open-source software projects, and an increasing number of open design projects, that build new post-capitalist ecosystems of value creation. These ecosystems of various CBPP projects are interrelated through their digital commons (the output of one project can be the input of another) and, thus, CBPP can be seen as a grand ecosystem consisting of diverse smaller, but not subsidiary, ecosystems and their institutions. Table 2 depicts the existence of the three types of institutions, as found in the four case studies investigated.

## Moving from micro- to macro-level: The commons trinity

As Bauwens et al. (in press) note, if we look at the micro-level, CBPP participants struggle to make a direct livelihood for themselves by contributing to the pool of digital commons. In most cases, they turn either to the state (payment by the state, for example via

**Table 2.** The three institutions of the case studies.

| | | | | |
|---|---|---|---|---|
| *Productive community* | Enspiral | Sensorica | Farm Hack | P2P Foundation |
| *Entrepreneurial coalition* | Enspiral Ventures e.g. Scoop, Loomio, Dev Academy, BuckyBox, Lifehack | e.g. BDan concepts, Blocksense | e.g. groups and individual members | P2P Lab |
| *For-benefit association* | Enspiral Foundation | Sensorica's designated exchange firm | Farm Hack | P2PF, P2PF France, P2PF Korea, P2PF Stakeholder Advisory Board |

public universities and publicly-funded science, or subsidies for culture and non-profits), or the capitalist market. So, the CBPP model should be seen as a prototype (proto-mode), since it cannot yet fully reproduce itself outside of the limits imposed by its interdependence with capitalism. In order for the CBPP model to move from a prototype into a full mode of production, some crucial steps should be realized.

CBPP's innovative activities take place within a context of capitalist competition, and because capitalist firms, which can access and utilize the knowledge commons, possess a competitive advantage over firms that do not and use proprietary knowledge relying only on their own research (Benkler, 2006; Tapscott & Williams, 2005), P2P and the commons are at times exploited by the extractive capitalistic models. According to Bauwens et al. (in press), the cooptation of P2P and the commons by capitalism is not a negative thing in itself, but rather a condition that increases the societal investment in a P2P-based transition. This cooptation means that capital flows towards P2P projects, and even though this distorts P2P, prolonging the dominance of the old economic models, it simultaneously creates new ways of thinking towards a more commons-centric society. This multidimensional interrelation between capitalism and the commons makes us seriously contemplate ways for the CBPP model to reach a commons-centric production mode, where citizens participate in the collaborative creation of value through commons. This would be a situation in which the commons capture capital and make it work for their own development. This type of reverse cooptation has been called 'transvestment' by Dmytri Kleiner and Baruch Gottlieb (Gottlieb, & Kleiner, 2016; Kleiner, 2016). Transvestment describes the transfer of value from one modality to another (in our case this would be from capitalism to the commons), and it seems that the trichotomous system that we have analysed here would help to achieve this, unlike the case where initiatives were disconnected from each other and from the broader ecosystem of the commons. Transvestment strategies aim to help commoners become financially viable and independent by 'taming' capital. The financial sustainability of CBPP projects is of crucial significance for its disengagement from capitalist extractivism.

Having already had an idea of what the cosmos of the CBPP ecosystem would look like, if it were not to be bound to a prototype mode alone, it is now time to reflect on ways to move from theory to practice. Using the CBPP ecosystem, presented in the second section as the blueprint of the micro-level, we hereby endeavour to portray a shift to

the macro-level. So, looking at the macro-level, the three aforementioned institutions could be said to correspond to the three great spheres of social life. The overall rationale is that the productive community corresponds to the civil society with its citizen-contributors; the entrepreneurial coalitions to the economic society of market entities; and the for-benefit association to the political society of the state (Bauwens et al., in press). The for-benefit associations of the CBPP ecosystems are, at the micro-level, a snapshot of 'the state of CBPP', meaning that they serve the 'common good' of the entire system. When seen at the macro-level, this allows us to look at the evolution of the state, in a commons-centric society, from a 'market state' to a 'partner state' (Bauwens et al., in press; Kostakis, 2011). Moving to a 'partner state' scenario, what we can anticipate is that, in such a state, the public authorities would empower and enable the direct creation of value by civil society, on a territorial scale, by creating and sustaining infrastructures for commons-based contributory systems (Bauwens et al., in press). Indeed, a partner state approach is already seen in some urban practices, such as the Bologna Regulation for the Care and Regeneration of the Urban Commons or the Barcelona En Comú (BeC) citizen platform.

The Bologna Regulation is based on an amendment in the Italian constitution which allows engaged citizens to claim urban resources as commons, and to declare an interest in their care and management. After an evaluation procedure, an 'accord' is signed with the city, specifying how the city will support the initiative with an appropriate mix of resources, and specifying a joint 'public–commons' management. In Bologna itself, dozens of projects have been carried out, and more than 140 other Italian cities have followed suit (Bauwens et al., in press). This innovation is radical in providing citizens with direct power to put forth policy proposals and transform the city and its infrastructure, and to function as an enabler in this. The key here is the reversal of logic: the citizenry initiates and proposes, the city enables and supports.

Moving about 1000 km from Bologna to the west, Barcelona has become a reference point for CBPP. This geographical shift indicates a shift as well in the focal point of our discussion. Barcelona is home to a great diversity of grassroots initiatives, from the commons-oriented crowdfunding platform of Goteo to the Cooperativa Integral Catalana to Guifi.net, a free/open telecommunications community network. Nonetheless, it is essential to keep in mind that Barcelona is not a city in reform from the top down; it is a city in transformation from the bottom up. This is how the BeC citizen platform emerged, took power, and currently governs as a minority in the City of Barcelona. The activist-level praxis matured into a political force, attempting to share its hard-won knowledge and experience internationally (Bauwens et al., in press).

In mid-March 2016, Barcelona hosted the Commons Collaborative Economies event (or 'Procomuns'), centred on producing public policy proposals for the commons economy. The event, which drew a huge, diverse audience from 30 countries, produced a joint statement and a series of policy recommendations targeted towards the Barcelona City Council, the European Commission and other local governments.

Within the small interstice (BeC holds 11 seats out of 41) between simple legislation and doing nothing at all, attempts are being made by BeC to embrace cooperatives and citizen activism, despite the numerous limits and problems at the government level. A novel, hybrid participatory process combining in-person and digital input has been

developed for city residents to collaborate in municipal debate and decision making (called 'decidem.barcelona'). This hybrid process is also being used in other cities in Spain, and is being promoted to cities internationally. The BeC platform has been built step by step, acknowledging every little victory that adds up to something that previously seemed inconceivable. Appreciation of the small steps is part of the change.

Without overlooking the aforementioned synergies with the state, a commons transition asks for allies further afield. Those are to be found among the forces representing the other modes of production and allocation. This implies uniting the forces which support the commons, support generative and ethical markets and support the development of an enabling and empowering state. Moving from micro- to macro-level requires commoners as the agents of change; and to have commoners, the sphere of the commons must expand.

## Conclusions

The participatory capacities of the Internet gave rise to online P2P networking, which successively gave birth to new models of production, both digital and physical. The capitalist models, using the capacities of users' communication and exchange, as a bait to fish for profit maximization, struggle for the control of proprietary P2P networking platforms (Bauwens et al., in press). On the other hand, the commons-based mode of production is continuously advancing, now expanding beyond the digital sphere into primary, material production. In order for the transfer of value from capitalism to the commons (transvestment) to be effective, higher level forms of organizations need to evolve, like those described in the current analysis. The trinity of CBPP institutions – corresponding to the civil society, the market entities and the state – simulates the natural environment in the ecosystem of the commons, and thus its vigour too. In contrast to the familiar comparison of societies with machines, CBPP and its generative practices can be better thought of as a natural living ecosystem.

Furthermore, there is an important desire within the world of CBPP to create an institutional framework that enables the products and efforts of CBPP to be exchanged and valorized without the need to form markets, or interact with states or capital (Arvidsson et al., 2016, p. 55). Different from both bureaucratic state power and the commodity logic of the market, the commons build on a definition of value that respects and reflects the irreducible diversity of particular local contexts and communities (Arvidsson et al., 2016, p. 55), and therefore, they develop their own institutions.

The aim of this essay has been to demonstrate CBPP as a generative P2P model of production and understand its transformative, yet tentative dynamics. We firmly believe that, for the further evolution of CBPP, a deeper understanding of its characteristics is required. Therefore, the emerging pattern of the trinity of institutions described here is useful, we believe. However, from our discussion so far it has become clear that, at the present time, CBPP is largely unable to reproduce itself outside capitalism. The economic sustainability of CBPP should be seen as a prerequisite of its future and its underlying transforming dynamics. But towards this important course, social and environmental sustainability that are promoted through CBPP should not be forgotten. As the notion of P2P spreads, so too should its capabilities be disseminated and advocated on a global

level. Any change in the production mode will only occur if a problem is first identified. In line with this, the fact that the users' 'peer identity' creates a value that is subsequently captured and valorized by capitalistic online businesses should at first be unveiled. Thus, the generative P2P alternatives, and their potential outcomes should be advocated globally. At this point, and if a transition from extractivism to generativism is any time close, CBPP and the commons dynamics may be unleashed.

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## Notes

1. Personal experience of the authors, Michel Bauwens and Alekos Pantazis, who are the founder of P2PF and core member of P2P Lab respectively.
2. Paragraphs of this section are based on Pazaitis, Kostakis, and Bauwens (2017).
3. Paragraphs of this section are based on the personal experience of the authors, Michel Bauwens and Alekos Pantazis who are the founder of P2PF and core member of P2P Lab respectively.

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# Tools from below: Making agricultural machines convivial

## ABSTRACT

*This paper explores Commons-Based Peer Production (CBPP) and the democratization of knowledge and technology in the field of agriculture. While most existing academic work mobilising these notions focus on the digital world, our two case studies – a legume-harvesting machine and a tool for hammering fencing poles – examine what happens when those notions are operationalized for hardware production. Our case studies take place in the context of Design Global, Manufacture Local (DGML) and look at the micro-level of practices, and the explicit and tacit knowledge that are mobilised when using open-source technologies to produce tools for the primary sector. We argue that the process of "open-sourcing" tools needs to be better theorised, and we show how this process mobilises expertise, experience, and engagement, connects various localities, and relies on representational practices. Our article aims to provide a better understanding of how digital commons interact with distributed physical manufacturing, what processes can lead to open-sourcing hardware and making technology convivial, and inform future research and policy proposals.*

Keywords: *technological sovereignty; open-source; agriculture; commons-based peer production; grass-roots innovation*

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# Εργαλεία από τα κάτω: Κάνοντας τα αγροτικά εργαλεία συμβιωτικά

ΠΕΡΙΛΗΨΗ

*Αυτό το άρθρο διερευνά την ομότιμη παραγωγή και τη δημοκρατικοποίηση της γνώσης και της τεχνολογίας στο πεδίο της γεωργίας. Ενώ οι περισσότερες υπάρχουσες ακαδημαϊκές εργασίες που ασχολούνται με τις παραπάνω έννοιες εστιάζουν στον ψηφιακό κόσμο, οι δύο περιπτωσιολογικές μελέτες μας –μια θεριστική μηχανή για όσπρια και ένα εργαλείο πάκτωσης πασσάλων περίφραξης– εξετάζουν τι συμβαίνει όταν αυτές οι έννοιες λειτουργούν για την παραγωγή υλισμικού. Οι μελέτες περίπτωσης αναπτύσσονται στο πλαίσιο του Σχεδιάζουμε Παγκόσμια, Κατασκευάζουμε Τοπικά (DGML) και εστιάζουν στο μικρο-επίπεδο των πρακτικών και της ρητής και άρρητης γνώσης που κινητοποιούνται όταν χρησιμοποιούμε ανοιχτές τεχνολογίες για να παράγουμε εργαλεία για τον πρωτογενή τομέα. Οι παρατηρήσεις και η ανάλυση που παρουσιάζονται στο άρθρο αυτό στοχεύουν στο να παράσχουν μια καλύτερη κατανόηση τού πώς τα ψηφιακά κοινά αλληλεπιδρούν με την κατανεμημένη φυσική κατασκευή, ποιες διαδικασίες μπορεί να οδηγήσουν στο άνοιγμα του υλισμικού και στη δημιουργία συμβιωτικών/φιλικών προς τον χρήστη τεχνολογιών και να πληροφορήσουν τη μελλοντική έρευνα και τις προτάσεις πολιτικής.*

Λέξεις κλειδιά: *τεχνολογική κυριαρχία, ανοιχτός κώδικας, γεωργία, βασισμένη στα κοινά ομότιμη παραγωγή, καινοτομία από τα κάτω*

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## 1. INTRODUCTION

In this paper, we focus on people who build their machines. We are interested in farmers who, due to necessity and/or conscious choice, do not buy commercial equipment to work their lands, but invent, create and adapt machines for their specific needs: for harvesting legumes, for fencing their land, for hitching tools onto tractors. Moreover, these people actively share their inventions via the Internet, thereby enabling other groups to do the same. The machines are thus just one part of the story, and the article will talk about the entanglements between people, tools, and knowledge that render the making and reproduction of these machines possible.

The material we present and discuss in this paper has been gathered through active involvement with practitioners. The first author (AP) is working on the convergence of convivial technologies, commons, and non-formal education, coordinating the socio-technical pilots of the COSMOLOCALISM project.[1] He has been involved in social movements while building a community of farmers and setting up a makerspace called Tzoumakers[2] in rural northern Greece. The second author (MM) has been working on – and with – L'Atelier Paysan,[3] a 10-year-old cooperative that builds open-source tools for small-scale organic farming. In particular, he has been involved in a collective research project (L'innovation par les usages, un moteur pour l'agroécologie et les dynamiques rurales) that ran from 2015 until 2018. Within this framework, he has participated to common reflections, supervised students, carried out empirical research and co-organised various conferences and meetings. In sum, both authors do not consider themselves as researchers that analyse open-source tools from a distance but as embedded and engaged researchers who closely collaborate with the actors in the field practising participatory action research.

Our paper is structured as follows. In the next part, we provide a theoretical framework by mobilizing and discussing texts about Commons-Based Peer Production (CBPP), Design Global, Manufacture Local (DGML), and convivial technologies. In the second part, we focus on two case studies: the construction of a legume-harvesting machine and the construction of a pole-hammering tool. In our conclusion, we discuss what the opening of a tool looks like in relation to the DGML concept, what such processes require, and how they can be reinforced.

1. https://www.cosmolocalism.eu/
2. http://www.tzoumakers.gr/ Tzoumakers is a commons-based peer production community initiative that brings together small-scale farmers and entrepreneurs to build and modify open-source tools and machinery with the purpose of fostering sustainable farming under the principles of design global, manufacture local.
3. https://www.latelierpaysan.org/English

## 2. LITERATURE REVIEW

### 2.1. *Commons as a mode of production*

Harvard professor Yochai Benkler introduced the term of commons-based peer production (CBPP) more than a decade ago, in the aftermath of the establishment of Creative Commons and Wikipedia in 2001. Benkler depicted in his book *The Wealth of Networks* (2006) how information technologies enable new forms of collaboration that can transform society and the economy. In the following years, Bitcoin as a virtual currency was launched, and Android operating systems based on open-source became widely used in mobile phones and other devices. Commons-based projects differentiate themselves from traditional business models with their less hierarchical and more decentralized structures, and by sharing the roles and tasks among participants.

In the same vein, the term "peer production" gained traction. It refers to goods and services that are produced or built by self-organized communities with the purpose of a shared outcome. The basic pillars of peer production are the openness of its outputs, decentralized organizational structures, and participant-driven work (Benkler, 2006). There are various successful examples of CBPP in the digital world in virtue of technological developments following the expansion of the Internet (Wikipedia, Apache web server, Linux operating system).

As a new way of value creation and knowledge dissemination, CBPP can be situated within the wider ecosystems of commons-oriented communities. CBPP infrastructures are generally equipped with open-source technologies. Thus its participants can communicate, organize themselves, and create collectively without competition (Bauwens, 2005; Benkler, 2006). CBPP is a community that shares resources to produce and manage a "common property". This common property – or the "new commons" to use Benkler's term – comprises all the knowledge, codes, and designs of the community. We consider this process as a CBPP ecosystem (Bauwens and Pantazis, 2018, p. 304; Bauwens et al. 2019).

The transfer of successful experiences of CBPP from the digital world to the physical world emerged only recently in the form of what has been called – among others – Design Global, Manufacture Local (DGML) mode of production (Kostakis et al., 2015; Kostakis et al., 2016) which took shape in places like makerspaces, fablabs, etc. (Niaros et. al., 2017). The present paper aims to contribute to this recent focus on peer production in the physical world by examining open-source technology processes in the field of agriculture.

### 2.2. *Democratization of knowledge and technology*

While the notion of peer production has emerged as an important reference point, there is a

variety of other notions and movements that have risen to prominence over the past few years and also call for the democratization of knowledge and technology as well as new forms of organization and concerns for the environment. Some of these terms include the world economy and thereby aim to requalify and rearticulate it: i.e. the circular economy, the blue economy, the sharing economy, or the social and solidarity economy. For example, the old model of agricultural and farmers' cooperatives is often confused with the Social and Solidarity Economy (British Council, p.81) but the former can have a great role if modernized under the SSEs' vision and practices. Other terms render explicit the wish to open up knowledge and involve citizens in the design and making of technology: i.e. do-it-yourself, prosumer (producer and consumer combined, see the similar usage in Bruns, 2008), open-source, hacking, making, and, of course, peer to peer.

Our paper is situated in these wider dynamics by exploring the sharing of knowledge and technologies in the domain of agriculture. However, in agriculture, these trends have not been much researched: most academic work has so far focused on open-source in the fields of computer hardware, software, and science (Kelty, 2008; Coleman, 2012; Söderberg, 2015).
Another notion, often associated with the above terms is the notion of "conviviality" and "convivial technology". In his book *Tools for Conviviality*, Illich (1973, p. 11) writes: "I choose the term "conviviality" to designate the opposite of industrial productivity. I intend it to mean autonomous and creative intercourse among persons [...], convivial tools rule out certain levels of power, compulsion, and programming". Elaborating on conviviality, he notes that "a durable-goods economy is precisely the contrary of an economy based on planned obsolescence. [...] Goods would have to be such that they provide the maximum opportunity to "do" something with them: items made for self-assembly, self-help, reuse, and repair" (Illich, 1971, p. 63). In *Deschooling Society* (1971), Illich argues that sadly we often confuse education with learning, medical monitoring with health, watching TV programs with recreation, and speed with effective transportation. Illich uses these parallelisms to highlight the contradiction when we confuse broader concepts like health with hospitals as the latter often exhibit many problems. We also confuse the multifaceted process of learning with western educational institutions. In the same vein, we tend to confuse technology with industry. Technology is not developed only in industry, and by confusing the two terms, we deprive our thinking capacity, already from the conceptual stage, from being capable of imagining a different technology that will not be a black box occurring in a vast, cold factory. Thus when equating technology with industry, we drift away from any possible alternatives of a humanized and democratized technology.

In a similar vein, the notion of appropriate technology captures some of the same

dynamics and ideas. As Vetter (2017, p. 2) argues: “appropriate technology proposed an alternative path to development using locally adapted materials and technologies that can be built, maintained and repaired without foreign experts”. What Vetter describes is that different types of technologies entail different underlying logic, world views, and therefore social imaginaries. Instead of being neutral, technologies are an ambiguous battlefield indivisible from social competition and power dynamics. Technology, when considered neutral can be “painted” Green more easily. However, when considered ambivalent, it opens up a whole spectrum of critical thinking that can help us to steer better the ICT revolution and our social reproduction model towards one that can be more socially just and less environmentally destructive.

Delving into the processes of making technology convivial, we aim to reveal patterns and practices that can help in further developing such notions. Thus, we will see people creating representations of tools (images, photographs, plans), manufacturing prototypes of tools, testing and adjusting devices, sharing information about tools, and organizing manufacturing workshops. To put it differently, it is only after a process involving transformations, dis-assemblages, and re-assemblages, translations, and representations that tools become open-source and convivial. We hold that open-source tools can be captured as a process in the making. At the same time, they can also be seen as a form of positioning – or even political statement – concerning forms of knowledge production and technology development that are problematic for various reasons: patents, technological lock-in, or monopolies. In agriculture, this tension between open-source tools and mainstream industrial tools has been explicitly addressed (see, i.e. Oliveira et al., 2014; Nicolosi and Ruivenkamp, 2013; Aoki, 2009). According to Boettiger and Wright (2006, p. 47): “open-source agriculture is more a restoration than a revolution. To agricultural scientists, [open-source] offers a promise of a return to the scientific environment of decades past, where materials and ideas were exchanged with greater fluidity and today’s preoccupation with intellectual property rights that was absent”. Rephrasing Boettiger and Wright, open-source agriculture when seen through the DGML lenses is more an evolution than a restoration: rooted in the natural commons of the past and blended with the momentum of the digital commons of the 21st century, creates something new.

Taking it further, Lemmens (2010, p. 144) talks of “a deproletarianized agriculture, in which farmers can take control again over the means of production and “be in charge” again of agricultural innovation”. He further writes that deproletarianization is “explicitly aimed at the reconstitution of autonomy and independence of farmers, who should become active innovators again instead of passive receivers and users of technologies designed outside of

their use-context, supplied with a technical code tailored to the imperatives of the corporate food system'' (Ibid.).

The cases examined in this paper can be understood through the notions and dynamics just discussed above, even though terms like open-source or conviviality were not necessarily used by farmers in the initial steps of some projects. L'Atelier Paysan is one of the few formalized collectives specialized in building open-source tools for small-scale organic farming (another notable collective being Farmhack)[4] and explicitly using terms such as open-source, appropriate technology, or common goods (Giotitsas, 2019). L'Atelier Paysan has developed a range of practices for ''liberating'' the technology of agricultural tools: construction workshops, video tutorials, a website and an online forum, books, and open-source plans of machinery. In their article, Chance and Meyer (2017) have analyzed L' Atelier Paysan by retracing their history and form of organization, studying how they enact the principles of open-source in agriculture, and by describing their tools within their economic and political context, creating different sets of capabilities for farmers in France and beyond.

Similar examples exist in Greece but at a much smaller scale. Melitakes[5] and Tzoumakers, the two groups examined here, only recently initiated a process of reappropriating technologies for the primary sector. This difference can be understood when focusing on the Greek economic and political context. Ethnographic research of the socio-professional profile of Greek farmers reveals various constraints. For example, Petrou (2014) argues that the tendency to return to the Greek countryside and engage with agriculture professionally is not efficiently promoted through institutional structures. Instead of supporting the whole process of socio-professional integration systematically, these structures tend to produce uncertainties, personal insecurities, and fears. The two initiatives examined in this article attempt to reduce those uncertainties, enhancing technological sovereignty, and thus empowering small-scale farmers.

## 3. CASE STUDIES

### 3.1. *A legume-harvesting machine*

In the village of Pyrgos (southern Crete, Greece), there is a small group of people called Melitakes (the Cretan word for ants) interested in seed sovereignty and agroecology. It is a group engaged in organic farming, trying to form a small food production and processing cooperative. One of the things the group does is to plant legumes in between olive-trees or

4. http://farmhack.org/
5. https://melitakes.gr/

grapes, a practice called “co-cultivation”. While olive trees are abundant in Greece, the land in between individual trees is usually not cultivated due to the distance necessary to avoid shading and foster the growth of the trees. So the idea was quite simple: exploit the unused land for planting vegetables that have lower light needs. However, the members of the group soon faced a specific problem: it is hard to harvest legumes by hand and there are no available tools to get this backbreaking job done in a narrow line between olive trees. On the market, there are big tractor accessories, suitable for such a job only for large monocultures. That is why the group sought the help of a friend in a nearby village, a machinist, to help them out. He liked the idea and started to develop a tool (picture 1). At that time, there were no concrete ideas or discussions of “open-sourcing” the tool and of “do-it-yourself” (DIY) practices. The situation was rather a pragmatic one: there was a need for a machine that does not exist on the market, a person was able to build it and a group was already there to initiate, guide, and support the process. So, a small legume-harvesting machine was built by combining the knowledge and experience of the machinist and Melitakes group members. At that period, students from a French environmental high school were on a trip of agroecological interest to Melitakes. Two of the students decided to make the design of an ant in a template and in this way the logo of Melitakes was made and printed on the machine.

Picture 1: *DIY legumes harvesting machine by Nikos Stefanakis and the Melitakes group*

Source: Alekos Pantazis.

Before continuing our story about the legume-harvesting machine, a few more details about L' Atelier Paysan are useful. L' Atelier Paysan is a cooperative that was created in 2014 and builds upon construction workshops that have been taking place since 2009. The methodology of L' Atelier Paysan consists of several practices: doing tours to make an inventory of peasant innovations; developing tools via testing, prototyping, upgrading, and realizing workshops; and "liberating" the collectively-validated tools via the publication of detailed plans and tutorials on the Internet. One of its most prominent tools is the quick hitch triangle (picture 2), which replaces the usual three-point linkage between a tractor and the tool to be fixed behind it. For the quick hitch triangle, L' Atelier Paysan has produced a 10-minute video, taken many pictures, issued a 47-page booklet, and drawn several plans – all of which are freely available on its webpage.[6] It is important to stress a key feature: it is not L' Atelier Paysan that develops new tools from scratch "in house"; rather, they actively look out for farmers' innovations. Only thereafter, through collective construction work, after testing the tool in the field and various processes of representation (plans, pictures, videos), are the tools released. Put differently, while user innovations are already there, "in the field", the role of L' Atelier Paysan is to collect, improve, formalize and disseminate these innovations.

Picture 2: *Construction of the quick hitch triangle*

Source: L'Atelier Paysan.

One of the authors of this paper (AP) took part in a 5-day workshop organized by L'Atelier Paysan in France in March 2018 to build two tools for organic grape crops. He gained several kinds of knowledge via the workshop: practical knowledge on working with metals (e.g. cutting and welding); theoretical knowledge (e.g. the organizational and financial structure and the problems faced by L'Atelier Paysan); and knowledge about how to run

6. https://www.latelierpaysan.org/Le-triangle-d-attelage-38

workshops. When AP got back to Greece, he visited the Melitakes group. He explained how L' Atelier Paysan works – its practices, philosophies, and ethics – and the various tools that have been designed and built. While thinking about the future development of Melitakes' tool and its possible diffusion by open-sourcing its design and using some of the standards developed by L' Atelier Paysan, the collective faced a new problem: none of them was a mechanical engineer. None of them could thus illustrate the design of the components of the legume-harvesting tool, not even the talented machinist who built the machine without plans, based solely on his experience. Yet, this was a crucial step for digitizing the design and making it accessible online. So, after being unable to find a mechanical engineer or designer willing to pay a visit to this remote village, they sought the instructions of architects for how to best illustrate each part of the machine. Subsequently, they dismantled the tool, took photos of each component (more than 300 photos in total) in the correct angles (90 and 180 degrees), and with a tape measure visible on each photo. They also used big sheets of paper to make the imprint of some complicated tool parts (picture 3). Moreover, they started looking for people who, based on the pictures and imprints, would be able to draw the mechanical design of the tool digitally and thus remotely support those two groups. They finally found a designer and enthusiast of the Tzoumakers group who was willing to help and thereby participate in the vision of sharing knowledge globally and enhancing farmers' tools sovereignty.

Picture 3: *Imprinting of some complicated parts from the DIY legume-harvesting machine made by Nikos Stefanakis and the Melitakes group*

Source: Alekos Pantazis.

The objective, at the moment of writing, is to draw the plans of the tool, render them open-source by publishing them on the Internet under a Creative Commons license[7], and then organize workshops to teach people how to build it. So, while the full story about the legume-harvesting tool has yet to be written, some features can already be told: a practical problem has been translated into a technical tool instigated by motives different from profit maximization; this tool has been disassembled and photographed in order to become "drawable" and thus available via the Internet. The hope for the future is that a lot more people, in many more places, will be able to build this tool, further improve it and share the improved design with the global community. But alongside the tool, something else will travel and be reinforced: the principles of agroecology and the practices of open-source culture.

### 3.2. *A tool for hammering fencing poles*

A common concern for farmers of the broader region of Tzoumerka in Northern Greece is that animals, especially wild boards, often damage their crops by entering their fields, and eating and destroying their crops. As they try to avoid the high costs incurred by having specialized fencing technicians involved in such a task, they fence their land themselves. This frequent task requires two individuals and is usually made by using barrels instead of ladders to get on the top of the pole and heavy-duty sledgehammers to nail it in the rocky, mountainous ground. This practice is difficult and risky because the land is usually not plane, so the use of ladders – let alone barrels – entails the risk of falling, and using a sledgehammer in such conditions entails risks for the assistant that stands underneath, holding the pole in a vertical position.

This is why the farmers and makers of the Tzoumakers community (named so by combining "makers'' and the "Tzoumerka'' region) got together. They first discussed the problems they faced and then mapped and prioritized their needs. Then, they proposed a set of solutions that they use, know, or have heard about and started sharing their experience. At the same time, the members more familiar with modern technologies searched the web looking for solutions to their pressing problems that people or groups like L'Atelier Paysan might have solved and shared before them. The appropriate solution for the fencing problem finally

7. Open hardware licenses are, at the moment, rather a niche and an emerging area of interest.

emerged from within the local community: a beekeeper and an owner of a nearby mountain shelter had used in the past a simple tool for hammering fencing poles. The tool does the job without acrobatics and risky moves being necessary, making it possible for only one person to hammer the poles while standing firmly on the ground (picture 4). They explained the logic of this tool to the rest of the Tzoumakers community and altogether set up a plan to build one.

Picture 4: *Testing the newly constructed tool for hammering fencing-poles from the Tzoumakers group*

Source: Alekos Pantazis.

A workshop was therefore organized in May 2018. The first preparatory step for the workshop was taken within the informal core community: a group chat and a coordination document was created and shared between eight people. After a face-to-face meeting and webchat discussions, the group created a list of tools and raw materials that would be needed to build the tool and each of the core members got the responsibility of bringing some of them to the workshop since the equipment of the Tzoumakers makerspace was not yet there (such as metal welding tools, angle grinders, metal tubes, pieces of solid metal, even a working bench). After this list was established, the workshop was advertised more widely via Tzoumaker's Facebook group, emails and phone calls to specific members of the mapped community that might be interested, and via a poster placed in nearby villages and local agricultural associations.

At the workshop, several explanations were provided to the participants including: the underlying logic of the tool; why it is more practical than a traditional tool; how the total weight of the tool should be calculated; and how much will it cost. Moreover, to ensure that the making process could be reproduced easily, participants kept records of various elements on a whiteboard (picture 5): the sequence of the steps needed for constructing the tool; the points to be welded; the required tools, materials and their prices; and some other useful details and observations. Also, a wooden device that helped the parallel alignment of the two grips during the welding of the tool was made and photographed. In other terms, the whiteboard functioned as a material representation, user guide and reminder of the "ingredients", and the temporality of the workshop.

Picture 5: *Presenting, explaining and recording key information to make the pole hammering tool at the Tzoumakers makerspace*


Source: Alekos Pantazis.

It is frequently argued that open design allows improvisation and circularity. During the process of making the tool, it became clear that a heavy piece of metal was needed to serve as the top of the new type of sledgehammer. Instead of buying one, this part was made out of a scrap truck axle that a member of the core community brought and that was cut into pieces. Such a process could have never taken place if a new tool had been bought readymade. Therefore, open-source local manufacturing enables the use of local materials and the re-use of scrap, significantly reducing the ecological footprint of a tool and enhancing circularity.

While the set aim was to build the tool, during the workshop, there was an element that surprised the organizers. At some point, the participants said that they wanted to inscribe "Tzoumakers'' on the tool. In other words, they showed that they cared not only about building a tool, but also about the collective identity that enabled them to create this tool. The inscription "Tzoumakers'' became a means to make explicit a sense of collective and common identity, similarly to what happened in the Melitakes group. By providing the means for building a tool for hammering fencing poles and inscribing a signature on it, the workshop enabled a close entanglement between the Tzoumakers and a tool: it became *their tool*. This "ownership'' also became evident at the end of the workshop, when a funny video was spontaneously made by one of the participants. The participant played a salesperson who praised the tool as if it was part of an advertising spot, saying for instance that "with this tool, I was saved! I fenced all whole village and now I can sleep peacefully''. After the sales pitch, another participant underlined that the tool was produced by Tzoumakers, while another one added that it is a "clever tool''. Even if this anecdote mobilizes fiction and humour, it nonetheless reveals pride and a sense of achievement in a moment of collective enjoyment. This sense of community was also established on a more serious level by developing ethics of contribution and reciprocity in the use of the tool. For example, while discussing the lending process of the tool with anyone who might need it regardless of whether he/she participated in the construction process, the idea of asking for a voluntarily small donation in the form of makerspace consumables gained ground. In this sense, the community is in line with the expression popularised by Stallman (2015, p. 3) "Think free as in free speech, not free beer".

It is important to note that several versions of the tool were created: a light version of 9 kilos that was also slightly shorter and a heavier version of 12 kilos. This had to do with both the size of the pole that was to be nailed and the body type of the user, thus inclusivity was embedded in the tool design process. The women users who are often excluded from design processes were taken into account in the design and production of this agrarian tool. Another adjustment was discussed two months after the workshop: an idea for improvement was to

place the handles of the tool vertically rather than horizontally so that the movement made by the user gets more ergonomic and less painful. This adjustment is to be implemented in the next version of the tool. The coexistence of several versions shows that what is at stake is not only the *reproduction of* a tool but more importantly, *experimentation with* a tool by its users, which involves testing, improving, and adjusting. During these phases of experimentation, the tool has to go through certain "tests" in the field. For instance, the tool not only needed to be able to accomplish a specific task, but it also had to pass an “ergonomy and physiology test’’. The tools need to be built in such a fashion that they can be used smoothly, naturally, taking into account the variability and contingencies of human bodies. This represents, for the Tzoumakers, a form of inclusivity and conviviality, and the stated aim is thus to create a sort of "library" of different models both physically and digitally.

At the time of writing, the two-pole hammering tools that have been built at the workshop are in the hands of farmers of the Tzoumakers community. One tool, for instance, was used for the construction of a greenhouse that was funded by a state subsidy for young farmers. Moreover, pictures and videos of the workshop have been uploaded, and a designer is willing to produce a detailed documentation of the tool (including ideally also filming). So, the next phase, after the prototyping of the tool, will be the design of a booklet that will include detailed presentation, an explanation of the usefulness of the tool, a list of all the equipment and material needed, instructions for building the tool (and the risks thereof), drawings and pictures. To sum up, we see that the open-sourcing of a tool not only involves experimentation and construction/reproduction, but that documentation is also crucial.

## 4. DISCUSSION

The building of tools within local communities is a practice that is usually experienced as positive and empowering. Yet, a model like the one from L’Atelier Paysan cannot simply be copy-pasted to another country and another context unmodified: a thorough understanding of both realities is needed. For instance, about 30% of L’Atelier Paysan’s turnover comes from public funding streams. L’Atelier Paysan is recognized as a leading network of agricultural development by the French Ministry of Agriculture and its adapted machinery method and self-build principles are adopted in the “Law for the future of agriculture” by the French National Assembly.[8] In Greece, aside from agro-industrial oriented subsidies, there is minimal public funding for small-scale agricultural activities, whereas there is no similar statutory legislation as in the French case. Apart from these political peculiarities, socio-cultural

8. https://www.latelierpaysan.org/Our-economic-model

characteristics also differ. For example, farmers' skills are different in the two countries (e.g. the level of digital literacy or the local farming knowledge), and the collective memory from building cooperatives in Greece experienced a harsh crisis in the recent past (Papadopoulos and Patronis, 1997; Rakopoulos, 2014). The conditions under which people can cooperate have their local "flavours" rooted in distinct habits and social imaginaries. There is no doubt that there are concepts and practices that can act as reference points globally. Yet other aspects need to be adjusted through continuous local observation, experimentation, and feedback, looking into everyday habits and processes up to regional and national policies.

In addition to this wider political and socio-historical context, our paper showed that natural, social, and geographical specificities needed to be taken into account. The kind of plants cultivated, the morphology of the soil and even the morphologies of users call for specific, locally adapted tools. In the case of the pole nailing tool, we witnessed the inclusion of different body types and gender by the making of tools with different weights and lengths. In the case of the legume-harvesting machine, we witnessed the influence of local geomorphological conditions: the machine has to be small and stable enough to move in the mountainous landscape between olive trees.

To conclude, we would like to emphasize two points. First, our case studies show all the work that goes into transplanting ideas, machines, practices, and knowledge between and across members of communities. This is not a simple move, it is not just a matter of copy-pasting an idea, a practice or a technology from one place to another, from one peer to another. Ideas, practices, and technologies are not immutable objects (unless patents convert them into such), but they are, in a sense, "quasi-objects''. For ideas and technologies to be transported and shared among people, they need to be represented, disassembled, and reassembled, translated, adjusted, transformed, and immersed into the local context. It is only by various interlinked actions – imagining, testing, photographing, drawing, theorizing, sharing, rebuilding – that objects can travel and multiply, that they become *common* objects. Also, for technological devices like the ones described to be low-tech and convivial, they need to be opened up not merely technologically but in several ways. This opening up is both a technical practice and a social endeavour. Connectivity, accessibility, adaptability, and conviviality of technology is a manifold issue that requires specific practices supported by specific social forms and processes, as well as political reinforcement. Our stories are thus not only about the practices of rendering agricultural tools convivial, but also about the (geo)politics, ethics, aesthetics and collective dimensions thereof.

Our second point concerns the way we might perceive the spatial dimensions of DGML. Peer production in open-source software has strong global aspects. Producers can

globally coordinate the production of software, later download and run it anywhere across the globe (given the necessary equipment and infrastructure). Yet, it seems that peer production in the realm of hardware entails some differences from its digital equivalent that call for more examination. Is a globally designed hardware equally easy to be manufactured locally? Will it be made identically in different places? How do manufacturing and social context affect practices and norms? What makes materiality different from the actualization of a solely digital item? These are some of the pressing questions to be further examined.

Through our participatory action observations, we have seen that DGML is not only something that relates two dimensions (global and local) but connects a whole range of sites in between them. For example, the designer that offered to draw the plans of the legume-harvesting machine lives in northern Greece and has never visited Melitakes group in southern Crete. The geographies of open-source agricultural machines cannot be subsumed to any neat divisions between global and local, or international and national. Various kinds of localities and spatialities are connected in our case studies: makerspaces, workshops, small communities, cooperatives, regions, national and natural contexts, etc. Different levels of localities emerge, and within and across these localities there are different levels and forms of engagement and different representational practices that potentially contribute to the process of "open-sourcing'' a tool.

Our case studies have shown that tools are not necessarily or easily "born" open-source. Making them open-source and convivial requires a lot of work and mobilises a variety of interlinked actions involving various types of expertise and levels of localities. Similarly to Bollier and Helfrich who prefer the term commoning instead of commons (Bollier and Helfrich, 2015), we should refer to open-sourcing rather than open-source in order to emphasize the process rather than the notion. By experiencing and observing the processes of DGML in action, we have tried to trace the patterns and sense what pieces of the puzzle are still missing. This could help practitioners find and create communication and collaboration protocols that will make scaling up possible in the same way that the social and solidarity economy needed to develop its norms, processes and organizational structures to establish itself as an alternative kind of economy (Nardi, 2016). DGML needs to develop its own norms and processes to be recognized as a new mode of production. In a nutshell, our case studies have demonstrated that the social, material, temporal, and spatial dynamics of open-sourcing agricultural tools deserve to be opened up for empirical investigation and theoretical problematization.

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# Teaching the Commons through the Game of Musical Chairs

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**Abstract:** In an attempt to reinforce the role of education on the commons, this article proposes the use of non-formal education activities and experiential learning. Exploring new ways to talk to non-expert audiences about the commons, I developed an experiential education workshop called "Musical chairs as a commons" by hacking the classic musical chairs game. I have delivered this workshop to diverse audiences during the last five years, from activists for the commons and NGO members to university masters students and scholars. This article presents the stages, the form, the content and the educational approach of the three-hour workshop and discusses further steps based on participants' reflections and criticism.

**Keywords:** commons, teaching commons, experiential learning, non-formal education

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## 1. Introduction

How can one explore and explain new ways of interaction with one another and with nature? Or, to pose another question, how can one describe water to a fish while aiming to explore new ways of swimming? Both questions are challenging as they refer either to unknown or deeply embedded concepts. Likewise: what are the processes of the commons?; what does 'sharing' mean when we mostly 'own' things?; how can one explain commons-based management of resources when there are dozens of private and governmental management systems? These are frequently asked questions among researchers, activists and advocates of the commons who often find it difficult to explain their basic concepts.

Engaging with the commons is a marginalised practice that often transcends the dominant narrative, embodying practices that are based outside of the main social imaginary of capitalism (Kioupkiolis 2019; Bauwens and Kostakis 2014). The essential characteristics of the natural and digital commons heavily differ from the profit-driven doctrine of our everyday lives. Thus, people often find it difficult to perceive the core notions of the commons. At the same time, commons are emerging in between the private and the public sphere, forming a third traction pole with radically different characteristics of social reproduction in the fields of decision-making, human relations, environmental sustainability, value production and more (Kostakis, Roos and Bauwens 2016; Kostakis and Stavroulakis 2013). If developed adequately, the commons can form a decisive

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alternative route that can help us overcome the extremely complex socio-environmental problems we are facing (De Angelis and Harvie 2014; Bauwens, Kostakis and Pazaitis 2019). Thus, being able to effectively communicate core notions of the commons can be of major importance.

This article stands as an endeavour in introducing non-expert audiences to the basic notions and principles of the commons, applying non-formal education and active learning concepts. The commons, as a socio-economic and political system, can only be understood if studied in terms of the community/resources relationship. This is why I propose an educational scenario for the commons to be met within a framework where a sense of community is created and participants are then urged to solve a resource management problem.

Any piece of knowledge, if explained merely in theory, is difficult to imprint in long-term memory. This is why the idea is to familiarise such audiences with the commons not only in theory but also in practice through processes that promote the 'learning-by-doing' concept. The approach of the workshop is that active participation evolves into constructive collaboration and later results in collective reflection and peer learning. In this process, I utilise Kolb's four-stage interaction (2015, 68) where the participants a) actively experiment on something, b) experience the activity, c) consciously observe and reflect on it, d) conceptualise and criticise what they observed, and, after shifting some parameters, actively experiment again.

The educational workshop under research is based on a variant of the popular game of musical chairs. This game is also known as the "chair game", "chair dance" or "going to Jerusalem" (Padula 2009, 410-411) and is known under similar concepts in different countries; as for example "Sandalee" in Iran, "Karrige" in Albania, "Sapoti" in Eritrea, "Sillas Musicales" in Peru or "Il Ballo della Sedia" in Italy (You Are What You Play 2020). It is practiced in Europe, Asia and America and has its origins in the 14th century, in a similar game that has been played in southern India named "Khambada Gadane" (Padula 2009; Kamat 2009). In Khambada Gadane, "players clutched available pillars in temples or large mansions as soon as the song ended or a cue was given" (Kamat 2009). Similarly to how Kamat describes the game of seven centuries ago, Alessandra Padula describes the current version of the game in *Encyclopedia of Play in Today's Society* (2009, 410):

> the players are counted and a number of chairs one fewer than the number of players is arranged, usually in a circle or in a line back to back [...] at the start of the game, the players stand in a circle outside the chairs. A nonplaying person, usually an adult, plays recorded music or a musical instrument. While the music is playing, the players in the circle walk, march, or dance around the chairs. The music suddenly stops, and each player must rush to one of the chairs and try to sit down as quickly as possible. Of course, there is one less chair than there are people, and one player is always left standing. This person is eliminated and play continues until one player remains.

There are slightly different versions of the game: in Albania, participants are found to be standing on pieces of paper named "musical islands" with one piece at a time being removed; in Italy a "musical broomstick" held between the legs has to pass on among participants and is dropped out when the music stops; and in Peru "a balloon is passed beneath squatting bottoms" (You Are What You Play 2020). Moreover, there is a cooperative version of musical chairs where chairs are removed, yet participants are asked to sit by sharing chairs or to sit on someone's lap (Padula 2009, 411).

According to Padula, the game practices visual, auditory, spatial and kinaesthetic abilities but only the cooperative version is considered to enhance the "ability to interact effectively in society, solving social problems and cooperating with others" (2009, 410). Thus, apart from the kinaesthetic skills, one might well ask what the social skills enhanced through the non-cooperative versions of the game are. On closer inspection, the 'classic' versions of the game of musical chairs fortify resource competition, individualism among players and possession via exclusion of the have-nots. This comes as no surprise, as McCabe observes, since board games had often reproduced dominant concepts, amplified damaging stereotypes and even contributed to colonial and neo-colonial ideology (2018, 647). In order to support his argument, McCabe refers to two well-known board games, Risk and Civilization, where the conquest and control of foreign territories and people "serve to normalise" colonial practices (2018, 647). Having its roots in the distant past, the musical chairs game seems to reflect some of the most dominant values of today's society. We laugh when excluded from the chairs because it is just a game, but if it were water, food, livelihood or shelter we had lost because somebody else got there before us, we wouldn't be laughing and we wouldn't consider it a game at all. It is difficult not to wonder about the social reflexes, subconscious norms and power relations that are reinforced through this game. But, as strong as the lessons of the classic game are, so can the lessons conveyed be if we hack the game based on different principles.

This workshop can enable participants to realise that plenty of the commons' applications are featured in their everyday lives, and they can also touch upon the ideas of researchers of the commons like Elinor Ostrom (1990/2015), David Bollier and Silke Helfrich (2019), Massimo De Angelis and David Harvie (2014) or Ugo Mattei (2012). Frequently, people may not even be aware of their exposure to aspects of the commons. To convert such ignorance to awareness, the game is deliberately designed to make participants experience a transition from the exclusive form of the classic musical chairs game, to an inclusive, communal variant of the game. After experiencing the commons through the game, participants are introduced to some basic theories about the commons and are then called to combine experiential and theoretical input by finding commons-based solutions within real-life case studies. The ultimate aim of this article is to investigate non-formal education and Kolb's learning cycle in understanding complex concepts like the commons.

The rest of the article is organised as follows. I begin with an overview of educational approaches that have influenced this workshop. Then, I review a few cases where the game of musical chairs has been adopted as an educational practice. I continue by giving a detailed description of the six stages constituting the workshop and, finally, I reach conclusions based on participants' reflections, and discuss future challenges.

## 2. Active Learning and Teaching Commons

Yoder and Bicksler were concerned about how to teach early-career students concepts of commons and institutions (2012, 364). As they put forward, there are plenty of academic programmes that contribute to research on the commons, but very few university courses that teach students about the commons. In their teaching project, US-based students were involved in a programme in Thailand to learn about "commons resource-dependent communities control and access regarding coasts, forests and rivers". Later on, they "transferred this learning to other, more familiar settings [that] are built into the field-based courses" (Yoder and Bicksler 2012, 363). Their case can be looked into from a political ecology perspective and within a framework they called "institutional arrangement" by which they aimed to guide the students' inquiries in the fieldwork. They used the term "institutions" (as introduced by Ostrom) as "sets of rules,

norms and strategies that formal and informal organizations use to govern resource ownership and access" (Ostrom 1990/2015, 369). After experiencing how communities manage their common resources, students were asked to apply acquired knowledge into their familiar contexts.

From a broader perspective, what differentiates non-formal from formal education is that the latter's focal point is hierarchical, often teacher-centred or knowledge-centred, advocating standardised knowledge dissemination; by contrast, non-formal education highlights students' participation in the learning process, putting the students' experience in the centre (Ngaka, Openjuru and Mazur 2012, 120; Blikstein 2013, 3). While informal education features an incidental accumulation of experiences or skills stemming from daily interaction with an environment, non-formal education stands as something between formal and informal (Dib 1988, 2-6). In fact, non-formal educational activities can be described as open, creative and resilient to changing conditions and individual needs.

Putting aside formal schooling and university experiences, which are often seen by the students as monotonous and suppressive, non-formal education programs are usually welcomed by those who are genuinely interested in acquiring knowledge and skills, often outside institutions. Thus, a profile of education as self-committed involvement and active participation usually leads to a more effective learning process. This is why such methodologies are particularly helpful when the task is to immerse students in new concepts, such as the concepts of the commons.

As many significant figures of educational theory such as Maria Montessori (Wentworth 1999, 44; 100), Lev Vygotsky (van der Veer 2007, 46) and Paulo Freire (2000, 82-86; Freire et al. 2001, 25-30; 78) have pointed out, learning through experience is a key concept that renders the active involvement of participants crucial. In the same vein, Jean Piaget established the constructivist learning theory (Kohler 2008, 256-257; Ackermann 2001, 3-4), while Papert characterised learning as "building knowledge structures" (1994, 207), making collaboration, communication and creative learning essential. Participants engage in a problem-solving process, which finally empowers the educational objectives (Ackermann 2001, 4-5). By contrast, in traditional education approaches, students cannot consider themselves as producers of knowledge. Moreover, in constructionist non-formal education programs, the role of the teacher is reshaped to that of a facilitator and guide who encourages students' self-motivation in the learning process (Cavallo 2000, 771). Under this perspective, experiential education, when put together with constructionism, utilises embodied memories from real-life experiences as 'building blocks' for learning that, linked with the designed and facilitated path of problem-solving or whatever educational trajectory the group follows, aims to connect experience and knowledge into new building blocks.

## 3. The Musical Chairs Game in Education

The analogy of musical chairs was first used in sociological research by Waldinger (1987). He likened the game to the economic integration of different ethnic migrant groups in New York's economic life. While seeking why various ethnic groups were successfully acquiring certain positions in the economic life of the city, he saw some structural determinants in this process. More specifically, he pointed out the race-based social structure of a country which led the people to be classified according to ethnic and racial characteristics, putting the dominant white culture in first place and the 'outsiders' towards the end. In such an order, migrants will find vacancies in positions that non-white workers would accept. This process puts migrants who want to be assimilated in the city's economy on a waiting list. Provided that this process may take years for newcomers, they usually follow their own community networks, forming ethnic concentrations: "niches"

(Waldinger 1987). Based on similar considerations, Rath (2000) investigated how Waldinger's empirical foundations could be built on in his own case study in Amsterdam. He examines whether the formation of "niches", as Waldinger termed them, exists and whether the migration patterns that resembled the game of musical chairs could be applied in a similar case in Amsterdam.

It seems that Susan R. Takata (1997) is the first documented person to implement the musical chairs game for educational purposes. In her article she describes how she implemented this game with a view to introducing the sociological theories of Durkheim, Marx, Weber, Lombardi and others to her students. As her inspiration, Takata (1997, 200-201) mentions Robert Fulghum, who revised the musical chairs game into inclusive practice instead of exclusive as in the original version. Based on this idea, Takata hacks the game, asking students to sit on someone's lap so that nobody is excluded from the game. Then, using Dewey's learning-by-doing approach, she creates links between the students' play experience and the sociological theories to be taught by urging students to connect their reflections on the game with sociological theories. She uses this game to introduce students to the basic sociological theories that she further analyses during her course, as well as to showcase that cooperation, rather than competition, can function as a means of accomplishing a goal. Among other reasons, she used this game in order to discuss issues like group-processing skills, the challenges of critical thinking, problem-solving and process-based learning (Takata 1997, 202). In Takata's course on introductory sociology, the chairs game "introduces sociology as a discipline and illustrates how fun the discipline can be in helping us to understand both global perspectives and our everyday life" as "it is an effective technique for shifting the classroom focus from competition to cooperation" (1997, 202). She beautifully highlights the essence of experiential education by referring to the old Chinese proverb "Tell me and I forget. Show me and I remember. Involve me and I understand" (1997, 204).

Being close to Takata's approach, yet unaware of her work, I was concerned about finding experiential ways to teach commons-related concepts. For the last five years, I have been advocating for the commons and introducing their concept to academic and activist audiences. As a result, I have had first-hand experience of the conceptual difficulties faced; at the same time, however, talking about these difficulties has provided me with a thriving space for experimentation. When I read Jose Ramos's article entitled "Reversing the Game of Musical Chairs: the Future of Work" (2016), I imagined transforming the article's main idea into an actual experiential educational game. Ramos compares the rules of the classic musical chairs game to capitalism and proposes the reversal of musical chairs as a model for the commons-based economy. As he articulates:

> Most of us are so busy playing this game, we hardly realise that we must step away to play a different game altogether. This new game we can call the "commons economy", in which one person's gain is not to the exclusion of the other, but rather considers and nourishes a whole social community and whole ecological system (Ramos 2016).

Based on the two different musical chairs games that Ramos envisioned, I developed an experiential education workshop named "Musical chairs as commons". In the following sections, I describe the process of this non-formal educational tool that advocates for the commons, analyse the remarks that came up during practice and propose further steps.

## 4. Presentation of the “Musical Chairs as a Commons” Workshop

The majority of people are aware that the game of musical chairs is played with a number of chairs and music. Participants walk or dance around the chairs, and when the music stops, the one that didn’t find a place to sit is expelled. The rules of the second version of the game reflect a strong intention to provide participants with cues about the notions around the practice of commons: when the music stops everybody has to find a way to be seated and nobody is expelled. This control over the conditions of the mainstream version of the game blazes the trail for the attainment of the study's objectives. It was hypothesized that the experiential style of learning would have a positive correlation with active participation and, at the secondary level, that participants' interaction with the commons-based form of the game would be preferred.

This workshop is a structured experiential process communicating the very basic concept of the commons. In particular, it aims to bring to the attention of a general audience a new mode of social forms and production that is based on the commons. It is a workshop that facilitates how people can acquire knowledge and form an opinion about the commons from experience. Given that the workshop is developed upon a game, participants have to actively perform certain procedures. Two different procedures direct the workshop: in the first, participants play the traditional version of musical chairs whereas in the second they play the revised version of the game. The transition from the first to the second game process enables the comparison of the two versions. It is therefore anticipated that participants will be overrun with emotions that differ, yet are analogous to each procedure. The comparison of the two procedures is evaluated individually by each participant based on the internal emotions and thoughts evoked during the whole process, but interpreted collectively in constructive and open rounds of reflection dialogue that take place among participants after each round and at the epilogue of the workshop.

The whole workshop is not solely inspired by the game but also developed on the basis of an experiential style of learning. This means that the workshop is divided into integrated, successive stages that participants go through in a fixed order. Play, reflection, lecture, group work and presentation are the basic learning ‘bricks’.

It should be mentioned that the workshop was held ten times involving, among others, masters students, NGO members, artists and environmental activists; the procedures were followed in the same manner, though slightly enriched by gained experience in the last versions. The workshop has six stages: in the first introductory stage, we clarify to the participants what experiential education is about and how a game can also be a means to education. Thus, people are motivated to participate mindfully. In the second stage, participants play the classic version of the game and, in each round, stop for a collective reflection where they are invited to share thoughts and feelings. In the third stage, participants play the hacked version of the game, also with intervals for reflecting. The fourth stage comprises a final big round of discussing and reflecting. The fifth stage includes an introduction to Ostrom’s principles, and to some more thinkers of the commons, and at the sixth stage, participants are divided into groups undertaking the task of forming management rules based on a real-life case of co-managing a shared resource. At the end, groups present their management rules and their reasoning, and a final roundtable discussion takes place.

### 4.1. Stage 1: Introduction

At the outset of the workshop, the facilitator begins with a short introduction of the main objectives and structure of the game and the addition of some information about the characteristics of non-formal education. The latter is included because few people are

familiar with such types of activities, so an explanation of why this is not a 'time-wasting game' but a structured educational experience and an encouragement for active participation is needed. Consequently, the facilitator outlines the first activity in which the participants will join.

Most people know the musical chairs game from their childhood, yet explaining the rules of the game to the participants ensures maximum inclusivity and the proper conduct of the game: for instance, participants' dancing instead of walking is not always granted, so a preliminary explanation helps to foster it. Also, a short prompt to think of the chairs as a resource like bread or water is made. This stage confirms conscious and voluntary participation as whoever does not want to participate is free to be an observer, which is also a role that may be utilised fruitfully. In turn, this voluntary consent to investigate the nature of the workshop enhances participants' openness to active experimentation.

### 4.2. Stage 2: Classic Musical Chairs

In the first form of the game, participants are asked to dance around the circle of chairs; when the music stops they have to sit, knowing that in each round there will be one chair less than the number of participants and that whoever is not seated will be excluded from the game. The setup of the chairs looks inwards in an effort to facilitate communication and interaction.

Engagement takes place within a predetermined setting: chairs and music constitute the basic instruments of the procedure. While playing, although participants seem to get carried away by the melody of the music, they are often observed to be staring at the chairs, perhaps out of fear of failing to take a seat when music is over. With either competitiveness or fear of failure driving their motivation, participants seem to grow more and more committed to the task as time goes by.

The participants left standing when the music stops are expelled from the game by the facilitator. Sometimes, a strict attitude towards the loser is intentionally adopted, so that greater emphasis is placed on the fact that this type of game is based on competition and exclusion. In each round of the game, a reflection circle follows on how participants acted and felt; i.e. the feelings of an excluded person or the reason s/he didn't find a chair are discussed.

Each elimination signals the initiation of a new round with fewer chairs. As soon as the music stops and one person is driven away from the game, the rest of the participants prepare for the next round. The more participants leave the game, the more focused on the game those remaining become. In every round someone is expelled from the game and a short interval takes place in order for participants to reflect. Some of the explanations were "it is his fault, he was too slow", "he was aware of the rules", "he was lazy".

Attention must also be paid to what the expelled participants stated in terms of how they felt and how they reacted: "I don't like being competitive, so I prefer to let others sit", "at the first rounds, I caught myself cheating – dancing but staring at the chairs – so I decided to be more relaxed". Others confessed that they expected to feel a lot worse for being eliminated than they actually felt: "while dancing around the circle the prevailing emotion is anxiety, now I feel relieved of the victory burden, it's better observing from outside".

In this view, the classic mode is a typical power game with players striving to survive on antagonism. It thus cannot be ignored that, in order to handle the sharp competitive atmosphere, participants decide to approach the game through antagonism and they put efforts into staying alert for the elimination moment while they –mostly pretend to – dance around the circle. When the game is over, the whole group of participants (along

with the excluded) is gathered back into the circle for final discussion and observations. People's comments are frequently concerned with their feeling stressed and nervous by the competition, or complaining that many are not really dancing. Some say that they enjoy playing because the rules are clear while others that they prefer to lose than having to act in such a competitive context.

### 4.3. Stage 3: Musical Chairs as Commons

In this stage, both the purpose and the setting of the game are switched. The main modification is that even though in each round chairs are still decreasing, no participant is excluded and they all have to find a way to be seated. Participants, once it was explained to them that they had to cooperate in order for all to have access to and enjoy the resources, started brainstorming. In this form of the game exclusion is no longer part of the procedure and the new challenge is that the community of participants have to mind-shift and treat chairs as a common resource. They are encouraged to think of chairs as a vital resource like bread or irrigation water. When the music stops, participants are given some time to think and discuss so that they can come up with inclusive solutions that by definition stand against ostracism and supremacy tactics. When all participants are seated, this means that they have made good use of their common resources.

However, participants were purposely not introduced to the ideas of commons so that they would be unbiased in order to first experience the commons-based game without preconfigured schemas or prejudices. Thus, they could reflect freely on what they would experience while playing, and only after this stage would they learn more about the commons and make links with their recent experience and prior knowledge.

The game begins and participants appear to be more relaxed. When the music stops, instead of running towards a chair, participants kindly offer their seat to another person and try to arrange the chairs so that no one is standing. Every round is followed by reflection. Chairs are getting fewer and fewer and participants remain in the terrain trying to find out ways to fit (Figure 1).

Figure 1: Photo of players of "Musical chairs as commons" workshop inventing ways to be seated (Author's personal archive)

After each round, a short discussion among participants about reflections on the second version itself, and the differences between the two versions, takes place. How do participants feel in the absence of competition? What does sharing a common resource mean in practice? What kind of collaboration, power relations and ideas took place and what kind of difficulties occurred? Such questions are posed during the reflection intervals.

The majority of participants agreed on feeling considerably less anxiety through knowing in advance that no one would be expelled, even though at some point there could be 15 people trying to fit on 4 chairs: “I was acting more loosely since I knew that I wouldn't be excluded or deprived of the resource”, “I was feeling safe while dancing since I had put faith in the community”. According to other reflections: “I felt like everyone was enjoying the game instead of being pressured by the condition of exclusion”, “I noticed that while dancing we were also interacting with each other”. At each round, participants share ideas regarding novel solutions on how they can all fit on the chairs. Some participants devoted time to brainstorming functional solutions, while others just enjoyed dancing.

Participants usually join the chairs in order for more people to fit. They also come up with innovative ways to do so such as offering their knees as a temporary place to sit or even removing the chair’s back, using it as an additional surface for sitting. The sociological characteristics of this procedure are rich. For example, females and males have the tendency to cluster; some participants try to organise the rest of the people or discuss solutions while others are just dancing; and people wonder about the actual state of sharing, which does not always mean that you get as much as you do in the state of owning.

### 4.4. Stage 4: Reflecting

Apart from the intermediate reflection sessions, the musical chairs game ends and the workshop continues with an overall reflection procedure. Participants openly express their thoughts and feelings and share opinions they formed after being exposed to the two different situations. By experiencing two variants of the same game, participants come to understand aspects of individualism – in the first version – and communalism – in the second version – and the practices of capitalistic and commons-based approaches that each game encapsulates. After they had compared the procedures corresponding to each of the two systems, participants were surprised by the divergence in emergent values. They also contrasted their prior knowledge or preconceptions to what they had experienced. Many mentioned that the fact that this classic, timeless children’s game could be associated with notions of competitiveness, inequality and self-interest had never crossed their minds. On the critical side, some experienced commoners noticed that the game is not needs-driven but resources-driven, downgrading the community’s role, or they questioned authority: “Why are the chairs reduced? By whom?” (referring to enclosures of the commons); “What can we do so that our resources are not depleted? Can we build new chairs?”. Criticism is usually voiced concerning the focus of the game, namely that it shouldn’t be so much oriented toward resources but that the group should focus on different needs for accessing the resource that each participant might have and on the collective governance model. Of course, the interpretation of all participants’ comments needs to be carefully taken into account.

Up to now, this workshop has been able to stand alone since the experience and reflections formed have mobilised a rich tapestry of emotions and thoughts. However, it can also serve as a preface for introducing approaches to theories about the commons that reflect on the ways in which people collectively manage their needs. As has already

been mentioned, Ostrom's theory and other theories about the commons were purposefully not introduced before participants had been given the opportunity to first live the actual experience unbiasedly, then to reflect and think for themselves based on both their new experience and their prior knowledge and thus create their own knowledge 'bricks'. Only then are they introduced to theories about the commons, before reflecting again.

### 4.5. Stage 5: Introduction to Theories about the Commons and Case Studies Group Game

The reflection phase ends with a short break. In the new phase, depending on participants' experience with the commons, the main aim is to introduce and explain the basics of Ostrom's theory and/or other theories about the commons. This stage combines the experience gained with new theory input, thus transforming the already formed mosaic of embodied and abstract information into a reasonably connected puzzle of knowledge.

Ostrom's theory and principles are significant for teaching about the commons. Ostrom was a leading figure in theorising the commons in economic sciences with her Nobel-Prize-winning study into the successful collective management of natural common-pool resources from the early 1960s. She examined hundreds of cases around the world where local communities managed natural common-pool resources. Ostrom's magnum opus "Governing the Commons" challenged Hardin's "tragedy of commons" theory (Ostrom 1990/2015) via her collected empirical evidence, proving that communities had self-governed their natural resources in a sustainable way for centuries, just the opposite of what Hardin proposed. The term "common", for Ostrom, merely refers to a resource shared by a group of people. According to her, communication is vital for the lifespan of a community that self-manages a natural resource. She believes that when a problem exists, members of the community will find ways to solve it through communication and interaction. On the other hand, she acknowledges that not all commons are successful and therefore that they may be dissolved. In order to understand why some commons are successful and endure over time while others dissolve, she developed the "institutional analysis and development framework", where she aimed to determine universal patterns in an attempt to explain the rules of successful commons. She defined these rules as "operational rules", "collective-choice rules", and "constitutional-choice rules" (Ostrom 1990/2015, 51; 52). Moreover, she proposed a set of 8 design principles (1990/2015, 90) that are significant in order to achieve successful, sustainable common-pool institutions. These are presented and discussed with the workshop's group.

The commons are a triad consisting of a resource, a community and the management rules that the community forms in order to co-manage this resource (Bollier 2014, 18). Putting it differently, the triad of commoning consists of "Social Life, Peer Governance, and Provisioning" (Bollier and Helfrich 2019, 93), thus is mainly about "creating and maintaining relationships" (2019, 93). Tomašević adds that the commons can be seen as the "social practice of governing a resource" through the institutions that a community of users creates (Tomašević et al. 2018, 74). Up to now, together with the participants, we have created an experience of how it can be to compete for or to share a resource, and have analysed some theories on successful management principles for natural commons, but we have slightly disregarded the actual process of commoning, which is where the triad shines: the actual deliberation among community members for the creation of collective rules. So, in order to put into practice everything that has been mentioned so far, participants split into groups consisting of 4 to 8 persons. The purpose is to focus on real-life problems and resolve them based on Ostrom's set of principles and the experience from the musical chairs game. Each group chooses to deal with a case and

has to discuss and design a set of rules in order to manage the resource. So far, we have used three cases, described below. In some instances, it is preferable to use only one case in order for the output of all groups to be easily comparable at the final roundtable discussions.

Case studies include:

- An off-grid town decides to create a wind power energy cooperative. After collectively choosing the size and installation spot of the wind turbines, residents have to set energy distribution rules and any other management issues. Participants are given, in the form of plastic cards, the annual amount of produced electricity, which is less than their total demand, and a list of the consumption rates of different needs. Additionally, participants are provided with a two-axes diagram that facilitates the discussion about their needs: the horizontal axis describes whether the need is a necessity or a luxury and the vertical axis depicts whether the need consumes low or high amounts of energy. Participants then have to analyse and agree on actions and rules for the best management of the available electricity among them.
- A town that depends on fishing in a lake needs to come up with rules about regulating the amount and type of fishing based on the fishing area, the quality of the fishing waters and the breeding periods. Participants are given the annual estimated amount of fish (which is less than their total needs), a list of needs for each fisherman and their different fishing tool capabilities.
- An agricultural village needs to come up with rules about regulating the amount of irrigation water among farmlands. Participants are given the annual amount of water that comes from the river, which is less than their total needs, a list of needs for each farmland, and the order in which the farms are located on the slope.

Based on their background, the reflections that emerged during the game and the discussion about commons, participants are now called to synthesise their overall experience and come up with community rules. After a while, each group presents its management rules and then a final round of reflection and discussion takes place. Some of the proposed ideas are: “Assess the needs of the community and then compare them with the available resources, don’t start with the availability of resources”, “Don't take scarcity for granted – instead, look for solutions that can meet the needs of each community”, “respect all community members’ needs”, “reduce consumption to meet the available resources”, “use technology to monitor resource consumption”, “prioritise community needs and agree on the ethical background of the rules”, “merge activities (e.g. cooking) in order to consume less resources” or “distribute the resource to each member according to his/her needs rather than dividing the available resource”.

The community, having experienced how a rule-imposing game like musical chairs can be turned into a community-empowering game, is now asked to suggest rules to frame real-life problems. This initiative aims at conveying the genuine principle of the philosophy of the commons: each community acts as a self-governing body, making decisions and establishing its own rules. This process, as analysed by Baur, is a way to reflect on how players behave in dilemmas related to the commons and how this influences the sustainability of resources (Baur, Liechti and Binder 2014, 658-662). Participants make final observations, and the facilitator of the workshop comments on the whole procedure and makes connections between theory, the case studies and the musical chairs game, or between the work of Ostrom and other researchers’ work related to the commons.

## 5. Discussion

The conception of this educational workshop was inspired by the will to best communicate the essence of the commons.

First, the classic musical chairs game stands as a representation of the dominant system. Provided that in capitalistic environments, community members' motivation for productivity is based on the pursuit of personal profit maximization and not on the contribution to a shared resource, we come to the conclusion that such an environment is produced in the first version of the game. The chairs, here, are treated as essential assets: if you don't have one, you are out of the game. The participants, being informed about the rules of the game, are actually pushed to become individualistic 'doers' who strive, in each round, to obtain an asset. Over time, the community is divided into two sub-communities: those who possess commodities and are seated, and those who don't and remain upright. Due to luck, or given that some participants are in a more privileged position than others, for example, possessing the ability to move faster or having larger bodies, the generation of competitive emotions and tension is unsurprising. What is most noticeable is that the exclusion stipulation and the reflection on it usually transforms the game into a deeper process rather than just another icebreaking activity.

The second, 'hacked' version of musical chairs stands as an experiential reflection of what a system based on the idea of commons could look like. Here, participants are once more members of a community: this time, though, chairs have to be managed as a common resource. Now, with just a small shift in the rules of the game, participants discuss and collaborate, offer their seats, smile at each other and join their efforts in producing innovative ideas to overcome scarcity.

The classic and the commons-based game are radically conflicting with regard to their overriding aim: the former aims at cultivating competitive intentions that would inescapably give rise to inequalities between members; the latter aims at strengthening members' relations by inclusion and collective practices.

In our case, the two games, apart from their goals, differ in their processes, too. In the commons-based game, the elimination process is out of the question, even though resources are scarce. In addition to this, the pressure on the scarce resources increases at each round as chairs become fewer but participants remain the same (in the classic game, the number of participants is one greater than the number of chairs, and participants and chairs are reduced at an equal rate, so the competition is always for one chair). As the resources are not enough for all participants, they start discussing and collaborating in finding solutions to their common problem, for example: connecting two chairs, thereby creating space where more than two people can sit i.e. mutualising common resources for the benefit of the community; or sitting on top of one participant's knees i.e. taking personal responsibility for helping the community; or removing the chair's back and using it as a sitting surface i.e. community innovation.

In order to bring out the experiential, embodied knowledge that is created in the game, participants follow a variation of Kolb's learning circle (2015, 68): in each round, there is a pause for reflection. Participants formulate extremely insightful observations. "I dance much more relaxed than I did in the previous game version", "It's nice to know that I am not going to exclude anyone", "I have time to enjoy the music while other people try to find ways to share the chairs while dancing: finally there is room for laziness!", "Why do we lose chairs?; Is somebody destroying them or excluding us from our common resource?; should we question authority?", "We should take care of the cause that reduces our resources", "We should take action, building chairs or repairing them, but should the ones that will do the maintenance sit more?", "Men and women tend to share chairs with people of the same gender, why is this happening?", "Sharing the same seat

with 3 people is not as comfortable as before, sharing is nice but demands more effort", "Maybe we should employ a form of rotation to make sitting less tiring" are some of the reflections that are often heard. Participants experience the remarkable difference between the two versions of the game, which leads to comparisons between the two processes and enforces the primary understanding of how commons-based management functions around a tangible resource.

Even though the workshop took place in different conditions involving various groups of participants, everyone managed a smooth and quick transition to the spirit of commons and very few complained about feeling oppressed for having to share. When something like this happened, it was discussed with the whole group and resolved. For example, in one case the group agreed to give to the person that disagreed with the co-management of resources one chair for himself/herself and this initiated discussions regarding the extent to which a community should respect individual freedoms and vice versa. Eventually, most community members enjoyed the sharing of resources within the framework of a free and indiscriminate resource-availability (even within a resource-scarcity situation), having practiced their communal creativity instead of personal competitiveness. However, we have to make clear that experiencing those practices, emotions and embodied interactions is at the most an elementary glance of what the commons might be. Nevertheless, from an educational point of view, I argue that there is a qualitative leap: once you've lived the experience, it is much easier to understand even more complex concepts about commons, and much harder to forget.

However, a number of identified weaknesses of the workshop and additional ideas that are either mentioned by participants or developed by the practitioner leave plenty of room for improvement, the most interesting of which are discussed below.

Most importantly, the experiential part of the workshop is resource-oriented instead of community-driven. It is difficult for a game that is based on possessing or sharing a chair not to focus on the resource.

Although from an educational perspective it can be argued that an individual's first ever introduction to the commons has to be as tangible as possible, a commoner would argue that we should place the focus on the process of commoning rather than on a narrow resource management issue. Ostrom's "closed" systems of commons management refer mostly to natural resources managed by geographically small, defined groups of people and, as it may well be argued, today's cases of commoning are much more complex, including various localities, digital sphere, power dynamics, social struggles and governance rules that diverge greatly from Ostrom's 8 principles. For a more detailed discussion, please see the excellent description of the evolution of the notions on the commons by Tomašević et al. (2018) and the short overview on the commons by Massimo De Angelis and David Harvie (2014).

Another issue is that the workshop is all about a depletable resource, which poses extra pressure on the community. This is a tough condition for the commons to flourish in and, in most cases of proper commons-based management, the resource is either stable or regenerating. Is there a threshold of scarcity in order for one to be able to co-manage a resource, and how can one trace it? This is the reason why both games usually end before there is only one chair left. Moreover, an idea of organising another version of the game where the resources gradually increase is considered. Can we co-manage our resources even when we have plenty of them, or do solidarity and conviviality flourish only in conditions of scarcity?

Scarce chairs simulate the case of natural commons, while immaterial resources like culture, information or knowledge are often considered non-excludable, non-rival or even anti-rival. Can we create a version of musical chairs and case studies that will simulate

cases of digital commons? How can we simulate the experience of sharing a non-rival resource? A resource that is strengthened when its users increase, for example as in the case of information and knowledge-sharing, has different intrinsic characteristics and management processes than the tangible natural commons (for a detailed description see Bauwens, Kostakis and Pazaitis 2019; Arvidsson et al. 2017; Arvidsson 2020). In musical chairs, the element of music is anti-rival – the more people listen to it, the more value it gets – but how can players manage music as a commons? Another idea is that in the case study of the energy cooperative, communities can have a digital app that will facilitate the sharing of the resource, for example an open-source smart grid app which will be developed and managed by the community. In such a scenario, natural commons and knowledge commons would have to be combined in a creative synthesis of management rules.

The second part of the workshop, where the introduction of theories about the commons takes place, should include a greater variety of thinkers, theorists and activists about the commons than Ostrom's contribution alone. Additionally, in the case studies stage, working groups could be asked to form capitalistic and commons-based rules and then to compare and reflect upon those rules. Money could be introduced to both versions of the game (e.g. someone with 'money' could buy extra chairs) and participants could thus reflect on whether/how money can change the dynamics of the concepts. Does the concept of currency exchange shift the rules of managing resources or do rules define the use of money? (This might be an important exercise for experienced commoners and activists.) Another case may be the assignment of secret roles to some of the community members. For example, a person could be given the role of the president of an association, giving priority to members' access to the resources. How do identity issues shift the way we act in commons-based management?

Another idea that was proposed by participants was to create two groups: some are humans and some are bears of the North Pole. Humans have chairs and bears stand on sheets of paper that represent ice. In each round, a piece of paper is 'melting' and removed. The group of humans has the capability to ask for extra chairs, but if they do so, more 'ice' will be melted from the bears' group. In this case, the sense of community expands to non-human beings and on a global scale. Do we feel differently when we have to share among humans than when we have to share with other, distant creatures like polar bears? How important is distance, personal contact, species proximity, community sense; and consequently how do they affect the practice of sharing?

Moreover, a possible addition to the workshop is to video record the participants (with their consent) during the first two stages and screen parts of the video footage during the final reflection. The body language between the two versions of the game is so strikingly different (intense vs. relaxed) that such a task would be strongly educative. However, the potential behaviour change or discomfort that some participants might feel knowing that they are filmed prevented me from trying this idea, even if it would help to develop knowledge about the commons by interpreting the visual choreography of our childhood game.

## 6. Concluding Remarks

The framework of this workshop is concretised through an experiential style of learning that uses a childhood's game and a reflection process that is based on a variation of Kolb's four-stage interaction. Thus, learners are continuously transforming experience into a learning process through reflection. Participants enter the learning cycle first by being introduced to the musical chairs game probably known from their childhood and then practice an alteration of the game's rules towards a commons-based logic. During

this process, participants are asked to consciously act and reflect on their experience. Next, participants are introduced to theories about the commons. Then, in a shift from thinking to doing once more, they are challenged to co-create commons-based rules for real-life case studies about sharing a resource. What seems to create deep learning outcomes is the association of the ways participants cope with sharing during the musical chairs game and deal with creating collective rules during the case studies exercise. Under this process, people both empathise and rationalise on concepts of commons, building an educational experience of what being a member of a commons-based community could feel like. This is the point where the embodied (and therefore mostly unconscious) lived experience becomes conscious through the reflection process. Thus, merging non-formal education with Kolb's cycle entails powerful educational dynamics.

Regarding the power that games may have, as Illich points out, when physical education games are performed in "warlike tournaments" they "reinforce the competitive nature of schools" (1971, 35) and transform "playfulness into competition" (1971, 36). Contrastingly, games like this workshop, when used to build "awareness of the fact that formal systems are built on changeable axioms and that conceptual operations have a gamelike nature", can "provide a unique way to penetrate formal systems" (1971, 35). Going further, we may ask: would societies based on other values have different games, and how can we envision such games? According to Yates (2015, 1) some of the processes that characterise prefigurative politics include the collective experimentation and creation of new social norms. The intention to create a new society "in the shell of the old" characterises the prefigurative strategy that "directly implements the changes one seeks" (Leach 2013, 1). Thus, creating alternatives inside everyday activities (Yates 2015, 13) brings to some extent the future we envision into this very present. Many contemporary commons-based initiatives can be characterised as prefigurative, for they challenge the dominant narrative of how societies should function and build alternative ways in the present.

According to Pechtelidis and Kioupkiolis, the educational commons is a vibrant pedagogical process that creates new forms of subjectivities which are based on horizontal relationships and collaboration. If, as Foucault (1980) says, the subject is a product of power relations, then new forms of subjectivities based on the commons can challenge power relations (Pechtelidis and Kioupkiolis 2020, 4). In a commons-based society, we could envision that exclusion-based, competitive games will be the exception and not the rule. Instead, inclusion-based, collaborative games will emerge, reflecting a "commonly shared moral conception of the ideal society" (O'Neill 2016, 2). We cannot learn to be collaborative through competitive games; thus we need to change the underlying concepts of our teaching and our educational workshops and create the conditions to experience new knowledge, norms and practices through a prefigurative commons-based education.

This workshop is significantly enriched by various comments and feedback that was sent to the author, as it has been shared freely since March 2019 as an online document and through the web-based platform of Peer to Peer University (P2PU 2020a), a grassroots network created by librarians and community organisers that "seeks to create and sustain learning communities in public spaces around the world" (2020b). We consider this to be an effort for prefigurative education both in terms of content, by seeking to create transformative commons-alike experiences, and in terms of form, by sharing the knowledge through open and peer-to-peer means.

However, various constraints are present, and this educational concept, being a commons itself, calls for more experimentation and improvement, as it can form a

stepping stone for live and powerful understanding of classical commons theories as well as opening up an experiential practice for contemporary radical commons.

We hope that this workshop will be experienced, implemented and enriched by many more facilitators, educators and practitioners. We also hope that many more people will reach a rooted perception that the commons is not the fairy tale of an older time but an inclusive way for building vibrant, healthy societies. Finally, we hope that the underlying educational philosophy of this workshop will spark more fascinating educational processes within the curriculum of universities and, also, outside them.

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# P2P Learning

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# Abstract

In this chapter we identify a wide variety of learning projects, platforms, tools, and methodologies which could be characterized as “peer-to-peer” and present their main characteristics along three core dimensions (curriculum selection, learning process, and knowledge abstraction). We then discuss how p2p learning processes can be encouraged, facilitated, and supported by digital and physical infrastructures, keeping a critical outlook on the often hidden power asymmetries that are always present at the infrastructure level. We pay particular attention to the case of small intentional groups of adult learners, and to four exemplary case studies -- two digital platforms and two physical spaces -- with similarities and differences, which help us to deconstruct and critically analyse the different dimensions of p2p learning identified.

# 1. Introduction

There are numerous terms referring to horizontal and collaborative learning processes and methodologies, like peer learning, p2p learning, cooperative learning, collaborative learning, connected learning, networked learning, experiential learning, self-organized learning, project/problem-based learning, DIY learning, informal learning, social learning, situated learning, connected learning, critical pedagogy, radical pedagogy, hacker pedagogy, hip-hop pedagogy, horizontal pedagogy, post-pedagogy, andragogy, peeragogy, democratic education, progressive education, open education, direct education, popular education, free education, freedom schools, free schools, deschooling, and more. While all of these terms refer in one way or another to the same ideal, the granting of more independence and freedom to learners, they can differ significantly on the learning situation for which they were devised and thus are most relevant for. Perhaps the most important difference concerns the age of the learners, which allows for different assumptions on agency and self-determination (e.g., between children vs. adults). Other important differentiating assumptions concern the type of knowledge (e.g., explicit vs. tacit) and the overall sociocultural context (e.g., Global North vs. Global South). Finally, technology has given rise to new possibilities extending existing terms/concepts or even introducing new ones.

We use the term peer-to-peer (p2p) to describe such processes, which makes an explicit reference to technological p2p systems. The reason is that technology is being portrayed today as a key actor for the democratization of education (Cronin, 2019; Knox, 2016; Williamson, 2015; Benkler, 2006) and we believe that is critical to better understand how technological tools can support p2p learning processes and the more or less hidden power asymmetries that lie behind the design and management of digital platforms themselves.

The term p2p was invented in the early 00s (Oram, 2001) with the appearance of Napster, a p2p file sharing application that revolutionized online content sharing. It instigated a big movement toward the decentralization of the Internet at many levels, but also toward stricter policies on copyright infringement. Computers at the edge of the networks were (re-)imagined as "peers" performing identical functions instead of "clients" connecting to powerful "servers". It is interesting that Napster

itself was not a truly p2p application in the sense that it depended heavily on a central server for indexing and searching content. It was only the actual transfer of content that was happening directly from edge computer to edge computer, without the mediation of a central server. What is interesting for our comparative work on p2p learning, is that the engineering analogy with p2p systems helps to see clearly how centralization and power asymmetries are often more or less "hidden" and they can appear in different dimensions of a system.

When applied to learning, the concept of peer-to-peer can have many different interpretations and systemic challenges as well. For example, there are many cases where p2p methodologies in terms of learning and knowledge production could be put in place by a powerful entity toward a subordinate group, like the employees of a company. More subtle influences and power structures could also exist in deliberately horizontal groups for various reasons, like a strong personality influencing a learning group toward a certain direction, or a digital platform promoting certain types of activities against others.

At a higher level there are numerous cultural, political, social, and other power structures that influence significantly learning. From the very early days of formalized, and conservative, education systems there have been liberating forces toward more “progressive” education, like those described in Rousseau’s famous “Emile”; and later by famous progressive educators like Pestalozzi, Montessori, Steiner who celebrated the individuality of children and their capacity to learn, stressed the role of family life and the wider society, but also this of nature and impulses and in general the importance of knowledge “beyond words”. As noted by education historian John Howlett (2013) “Rousseau's Emile grows up in an environment designed, manipulated, and controlled entirely by the tutor.” This pattern of observations, acknowledging liberating features of p2p learning approaches toward one dimension of learning but stressing power imbalances in others, will be used often in the following.

It is important to stress that this long thread of innovation around progressive education concerns mostly child-centered education. For adult learners, there is much less written and formalized. Andragogy (Knowles, 1980) is perhaps the closest concept to the idea of a p2p learning group, and Plato’s “Symposium” one of the first documented peer learning processes between adults. To structure the discussion, we have chosen three important dimensions of learning to refer to while analysing various examples of methodologies, tools, and practices.

1) **Curriculum selection**: the choice of the learning objectives of an intentional or unintentional learning group.

2) **Learning process**: the different roles and interactions between different actors involved in the learning project, and their evolution over time.

3) **Knowledge abstraction**: the production of knowledge in the form of encyclopedic entries, tutorials, guidelines, tools, methodologies, patterns.

Note that there is already a lot of existing work aiming to summarize, classify, or analyze learning processes, which often focus more on one or two of these dimensions (Topping, 2005; Wegner, 1991). Some of these high-level analyses are contextualized, like the education system in the US (Giroux, 2011; Monchinski, 2008) or Sweden (Laginder et al., 2013). Others focus more on the technological dimension (Deimann, 2016; Williamson, 2015), while others more on the political aspects (Haworth, 2012; Means, 2014).

There is also a body of literature on peer production, peer-to-peer and the commons. Benkler (2006) has coined the term “commons-based peer production” and discussed different areas of peer

production. Bauwens, Kostakis and Pazaitis (2019) have explicitly linked the term peer-to-peer with the commons envisioning a societal transformation based on commons-based peer production and making thorough research and concrete proposals.

While our analysis will be based on work carried out in different educational settings and different contexts, our main focus and contribution will be on intentional adult learning groups. Among the different projects introduced, we highlight four specific ones, which share an important common characteristic: they are examples of p2p learning processes that include face-to-face interactions:

- The P2P University (P2PU) and Openki.net online platforms for creating and supporting self-organized learning groups in localities.
- The Tzoumakers rural makerspace in Greece and L200, a central self-organized space in Zurich, Switzerland.

In the following, we introduce the three identified learning dimensions (Sections 2, 3, and 4) analyzing critically a selection of existing approaches in terms of visible or hidden power asymmetries. In Section 5 we analyse the underlying infrastructure, digital and physical, needed to support p2p learning projects. Section 6 concludes the chapter with a discussion on the need for a continuous struggle for democratic governance and empowerment, for which one of the most important tools is “reflection in action”.

# 2. Curriculum selection

When one uses the term “p2p learning” in an online search discovers projects and initiatives of very different scope and perspectives ranging from the P2P University, the “home of learning circles,'' to a whitepaper by the Versal Group, Inc. On the one hand, in P2PU’s understanding, peer-to-peer learning starts from creating and sustaining learning communities around the world and training facilitators to organize their own networks developing/curating open educational resources (P2PU, n.d.). On the other hand, the Versal Group (2016) sees p2p learning as a means to “help your organization transition into a ‘learning organization’; become more agile and competitive; heighten collaboration and productivity” (p.2).

In general, there are always actors, like the state, the family, the market, the community, that influence what people choose to learn. Making such choices more conscious and more independent is part of the essence of p2p learning. Ivan Illich (1971) warns us that “Everywhere the hidden curriculum of schooling initiates the citizen to the myth that bureaucracies guided by scientific knowledge are efficient and benevolent.” In his last book “Pedagogy of Freedom”, Paolo Freire (1998) firmly defends the role of the educator for protecting the freedom of the students. “Freedom is not the absence of limits. What I have always sought is to live the tension, the contradiction, between authority and freedom so as to maintain respect for both. To separate them is to provoke the infraction of one or the other” (Freire, 1998:99). More radical thinkers around education, although appreciating the impact of Freire in our thinking about education, criticize the “moulding” approach (e.g., Firth & Robinson, 2017). The fields of critical pedagogy and radical pedagogy, among others, address in depth such questions of power in terms of the object of learning.

Especially for adult education, technology can play a key role, offering practical implementations of the vision of Ivan Illich (1971), the “learning webs” (long before the internet), presented as “the inverse of school” (p.52). Digital platforms like P2PU and Openki.net, are designed exactly to play the role of a modern learning web by facilitating, among others, the creation of ad-hoc learning groups around different topics of interest.

**P2P University (P2PU)** defines peer learning through three beliefs, described by Grif Peterson (personal communication, November 2019) as follows: "Learning is social, people develop expertise through their own lived experiences, and feedback is necessary in order to improve. It is not sufficient for these to be maxims that are spoken to within the learning circle. The process for assembling the group, the tools that support it, and community that supports it must also embody this mentality." The basic "frame" developed by P2PU through the overall narrative and design details of the platform is that there is a huge amount of knowledge available on the Internet, on various online learning platforms like Coursera, Khan Academy, and the like. But since "learning is social", why not create learning circles that can decide for themselves what to learn from this wealth of knowledge, using p2p learning methodologies?

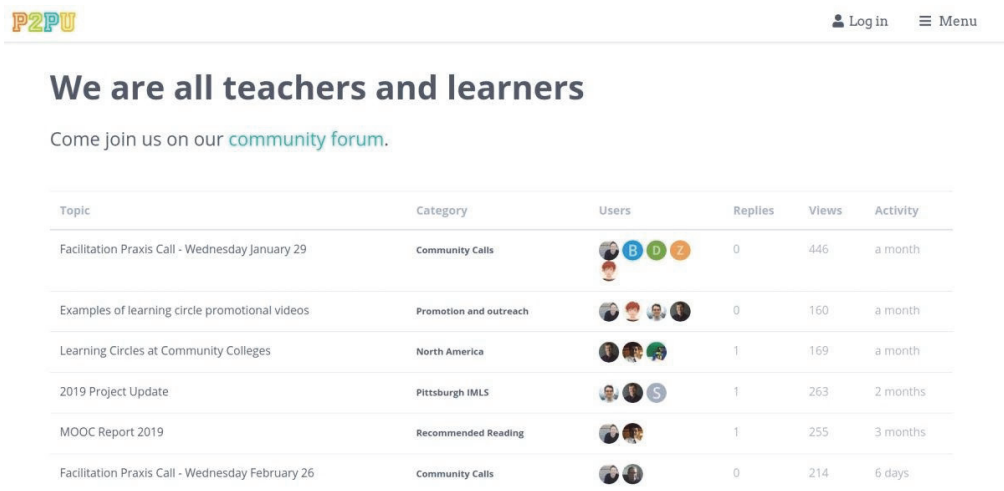


Figure 1: P2P University community forum

The so-called learning circles, are imagined as groups of people meeting once a week for 6-8 weeks and the role of facilitator which does not have to be an expert on the content, is central for bringing together the group. For selecting the actual content, special guidance is offered through the P2PU's facilitator handbook.[1] It directly addresses a candidate facilitator of a new course: "What gaps for knowledge acquisition do you have in your community? Who do you want to serve? What are you excited about learning?" To facilitate the collective process of creating learning circles, P2PU maintains a database of online learning resources. As Grif Peterson explains "The goal is not to be a search engine of every online course, but a community-curated tool of high-quality free and open access materials", which is not static but always open for the addition of existing courses or the creation of new ones.

**Openki.net** is a project based in Zurich with similar objectives, which has developed over more than eight years a custom open source platform. The Openki platform looks more like a search engine than a forum, as in the case of P2PU. The goal is to create an attractive online place where people build their learning groups and learn things that are not necessarily already available as online courses. One of its novelties is that the platform is designed in a way to strongly encourage the creation of courses in the platform by those that just want to learn rather than those that have the capacity to teach or would like to play the role of the facilitator. Literally, a bottom-up learning group

[1] https://www.p2pu.org/en/handbook/starting/

creation process. When such a project grows significantly, however, the need for filtering will become more and more apparent. Then an important source of power becomes indeed the prioritization of certain learning topics over others, or even excluding those judged as inappropriate.

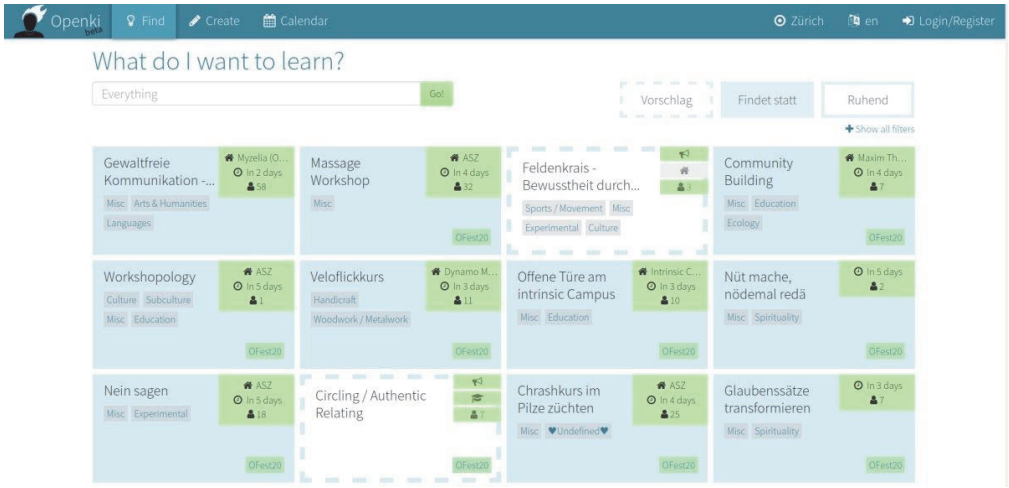


Figure 2: Openki home page in Zurich (accessed, March 3rd, 2020)

What is interesting about both P2PU and Openki is that they put in place technological tools for facilitating face-to-face instead of strictly online learning processes like MOOCs (Knox, 2016). This type of "blended learning" is very important to guarantee that p2p learning processes are really democratic and can form defenses against powerful actors like mass media that can create "hidden curricula", and influence significantly seemingly free choices. As Dewey (1927, p.213) stated "Democracy must begin at home, and its home is the neighborly community."

Study circles in Sweden is another project that shares this local perspective of creating p2p learning groups (Laginder et al, 2013). However, not special care is taken to facilitate the creation and organization of such groups, which were traditionally formed in the workplace. Today group formation is left to the group, and special institutions provide support to already formed groups. Funding is an interesting dimension, which on the one hand stimulates significantly such processes but also adds an important power element in the overall structure.

In learning projects that narrow down the learning scope, like in participatory design/making projects, there is also a lot of room for selecting the actual object of learning, or better learning-by-doing, as in the case of the **"Tzoumakers" project**[2]. Tzoumakers is a rural makerspace initiated by the P2P Lab[3] research collective, inviting the locals to design and build open source agricultural tools for their everyday life and work. The choice of tools is on them, inspired by like-minded people (e.g. practitioners from L' Atelier Paysan community in France[4]) working together with the locals to translate their needs into solutions and their solutions into tools. For Tzoumakers, it is interesting that the facilitation team has no expertise on the technical aspects of the making process, but their main task is to develop methodologies on the process and codify the knowledge produced to make it easily applicable and replicable.

[2] http://www.tzoumakers.gr/english/
[3] http://www.p2plab.gr/en/
[4] https://www.latelierpaysan.org/English

# 3. Learning process

Assume now that a group has been formed and has selected, democratically or not, a topic to be learnt in collaboration. How the following learning process is organized and in which ways and to what extent could it be “peer-to-peer”?

## 3.1 Roles

There are different roles in a learning process, those of the Learner/Student/Participant, and Teacher/Mentor/Expert/Facilitator being the most prominent in terms of function, but most importantly in terms of relationships between each other. For instance, an interesting analysis and comparison of the words “learner” vs. “student” by Biesta (2010) considers the word “student” as more empowering since students gain themselves, through study, the needed knowledge and the teacher only needs to encourage them to use their own skills (Rancier, 1991). She proposes the term “speaker” to signify an active agent in the learning process who not only listens but also speaks. We chose the word “learner”, as “student” is connected to traditional education and the “classroom”. The term “speaker” is more of a qualitative term and it is actually our objective to explore settings, methodologies, and technologies that enable learners to become “speakers”.

For highly technical or scientific topics, the role of the expert is central and it can be very costly, or even impossible, to be eliminated. As Dewey (1927) notes: “The man who wears the shoe knows best that it pinches and where it pinches, even if the expert shoemaker is the best judge of how the trouble is to be remedied” (p.207). But skilled teachers or experts are not always the best candidates for transferring their knowledge (Illich, 1971). They could be useful as “sources” of information but not always the ones to facilitate the learning process. For this role, the concept of a facilitator better fits the p2p ideal as analyzed in the “facilitator handbook” by the P2P University[5], among others.

In the vocabulary of P2P University, “content” is an additional core element expressing already developed online learning material which could act as an “expert source” of learning for a p2p group. Openki.net explicitly names more “operational” roles for an Openki course, like the host or organizer, and ongoing development of the platform aims to introduce even more predefined or customized roles like the note taker, researcher, communicator, and more. The Peeragogy Handbook provides a long big list of such potential roles in peer-learning projects: “Team Member, Manager, Leader, Reviewer, Editor, Author, Content Creator, Presenter, Designer, Graphic Artist, Technologist, Participant, Coordinator, Planner, Mediator, Moderator, Facilitator, Proponent, Advocate, Representative, Contributor, Activist”. (Corneli et al, 2016, p.17)

Of course many roles are possible depending on the specific topic and the context, and do not have to stay fixed. A learning group can start with an expert taking the key role of mentor, but along the way the learning process could be gradually more empowering for the rest of the group so as to feel ready to take the mentor role in the same or different groups. The learning methodology could also explicitly give the teacher role to the learners as an effective way to learn.

In Tzoumakers makerspace, the participatory making of designed global and manufactured local tools entails a variety of roles from “external experts” invited to a hackathon and local experienced craftsmen to “facilitators”, local designers, programmers and coordinators of an event. Moreover, the local community often draws ideas from the designs of tools that other communities worldwide have shared freely via the internet. Codified knowledge in the form of a freely distributed

[5] https://www.p2pu.org/en/handbook/

mechanical design or a youtube video inspires and teaches a distant community in various p2p ways to build actual tools, improving their everyday life.

Figure 3: Tzoumakers space

There are often important roles that are not particularly visible in the actual learning process, like this of a funding body which can significantly influence the formation of groups and the topics of learning. The case of study circles in Sweden is very characteristic to this end, “an activity whose charter is ‘free and voluntary’ but which, for its very existence, depends on state subsidy” (Laginder et al. 2013, p.19). In Tzoumakers, funding plays a delicate role since it usually places the initiators and facilitators of the process in a powerful position. For example, participatory action research entails affecting and observing the whole process at the same time, but the opinion of the group that injected most of the funding for the realization of the project, indubitably waits more. The equilibrium in such circumstances should and can be found most often through developing mutual trust.

P2p learning processes can also take place between “groups” rather than individuals, as in interdisciplinary or transdisciplinary research, and mutual learning or knowledge exchange programmes (Boehm et al., 2017; Healey & Upton, 2010; INURA, 1999). Such roles are always representational, in the sense that the groups that engage in the interaction represent a bigger group, a discipline, a traditional practice in a certain country, etc. NetHood Zurich, has acted as a facilitator for knowledge exchange and transdisciplinary research on various areas of commoning through a series of EU projects COMPARE (2015), MAZI (2016-2019), and netCommons (2016-2019), which all met in the design of a new collective space in Zurich, L200, co-founded by NetHood and now run without any external support. The ability to engage in an action research project without external dependencies is a particularly luxurious situation both for the researcher and activist roles, which allows to experiment with a structured laissez-faire methodology of participatory design (Apostol & Antoniadis, forthcoming), which does not pose any constraints on the use of the space, except from a strict rule of non-domination of its identity.


Figure 4: L200 entrance at Langstrasse 200, Zurich

L200[6] offers today a hybrid, digital and physical, platform for citizens to express their needs and ideas, and learn together, not through answering an online questionnaire or raising their hands in a public meeting, but through a direct action of their choice. The main role of the researcher(s) in action is to be reflective and to analyze the process informed by different fields and disciplines, toward the generation of knowledge for the infrastructuring of the space itself. As space coordinator, the main role of the activist is to make sure that the members of the association feel the space as their own, free to use it as they wish, through carefully designed tools, rules, and processes, both physical and digital, that are infrastructuring the commoning activities that take place on "top" of the common infrastructure that the space provides.

## 3.2 Interactions

Moving from the different roles that peers can assume in a learning process to the actual enacted relationships and interactions that take place during the process itself, there is a wide variety of learning methodologies to consider. These methodologies follow in principle the "learning as participation" instead of the "learning as acquisition" metaphor by Sfard (1998), which assumes that "learning is more akin to apprenticeship" instead of considering the mind as "a container to be filled through knowledge and learning".

There are many variations depending on the quality of the relationship both for "links" between actors assuming some sort of hierarchy, like between learners and experts. For example, Paolo Freire was in his classroom an uncontestable authority, but he was guiding his students toward autonomy. And even when the students are children, there are ways to transform the learning process to a more empowering experience (Howlett, 2013).

Similarly, even in the most horizontal models there are often inherent asymmetries of knowledge, skills, and position, and it might be more harmful than beneficial if they are not acknowledged from

[6] http://langstrasse200.ch/

the start (Freeman, 2013). Often in groups, it is more difficult to deal with informal hierarchies than with clearly stated ones. But "dealing" does not mean to eliminate special roles, since they are often necessary, but to make sure that such roles are not exclusive, concealed or authoritative.

The most "traditional" p2p learning methodologies, are clearly hierarchical in that a strong figure (teacher, instructor, mentor) is clearly leading the process and the focus is on the benefits of encouraging peer interactions among the learners. In short, the main idea is that one can learn better the object of learning (the content) when one is brought in the position of the teacher. Peer instruction, Peer Tutoring, Cooperative Learning, Collaborative Learning, Learning by Teaching, all fall into this category and reading the corresponding definitions one can hardly understand what is the actual difference between them.

When there is no expert, nor a powerful authority to dictate the process, a facilitator could help peers to reach a certain learning goal and make sure that they do not only "learn" but they also "speak" (Biesta, 2010). Going back to our technical p2p file sharing systems, they do not only "download" content, but they also "upload".

**Experiential learning** (Kolb, 2015; Kohonen, 2012; Dewey, 1997) is an example of a methodology that promotes p2p interactions and a participatory approach of learning. Experiential learning focuses on a specific collective activity or experience, whose outcome is not a priori defined. Learning-by-doing, active participation and experimentation are the main pillars of this approach. Kolb's circle proposes a cycle of multiple brakes for reflective observation, a rotation between abstract conceptualization, active experimentation, concrete experience and reflective observation (Kolb, 2015, p. 4). Thus Kolb's circle drags up the experienced learning from the subconscious to the conscious level, making learning accessible and taking experiential learning one step further. The role of the facilitator is then to design the common experience, the moments of reflective observation, and the conceptualization process. One of his/her key tasks is to balance the excitement of the collective action and the need for self-reflection and deeper understanding.

In other patterns of p2p learning interactions, like the simple sharing of personal experiences in a group, facilitators need to make sure that all voices are heard and respected. For example, in "Consciousness-raising (CR) groups", defined as "voluntary, usually women-only, regular discussion groups" the collective learning process includes the "recounting and interpreting the experiences of participants, generally by presenting members' experiences around a defined topic and then drawing out similarities and structural relations to the oppression of women." (Firth & Robinson, 2017, p. 66).

Another pattern of p2p learning is the existence of an intermediate object, like the so-called **boundary object**, a term coined by Star & Griesemer (1989) to mean a shared space, a common object "both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (p. 393). These different groups are often referred to as "social worlds" and the basic assumption is that "consensus is not necessary for cooperation nor for the successful conduct of work" (p. 388). Facilitation in this case is more demanding and requires the balance of power asymmetries that are often hidden, the lack of a common (disciplinary) language, and time constraints, among others (Apostol & Antoniadis, forthcoming).

All the above examples of methodologies and patterns of p2p interactions make sense independently of technology, which not only significantly affects the content of learning and identities of the learners and their "way of thinking" (Williamson, 2015). It also affects the process itself, giving rise to new patterns of interactions like the so-called connected or networked learning, which take place in dedicated environments (MOOCs) or "in the wild". The Internet becomes thus a

global educational platform, which from one side empowers people giving them access to information and knowledge, but on the other hand leaves learners alone, self-learners, decontextualized and in reality powerless.

# 4. Knowledge abstraction

It is not difficult to argue that how knowledge is abstracted, documented, and represented plays a key role in how it will be consumed, integrated and further produced. There are different forms of knowledge, others more explicit (knowing that) and others more tacit (knowing how). Texts, songs, drawings, images, graphics, films, formulas, recipes, social norms, institutions, laws, tools, patterns, blueprints, objects, statutes, machines, language itself, are all abstractions of knowledge produced and developed over the history of human civilization. It is very often that learning groups base their common seeking of knowledge on existing books, or online information. But learning also produces knowledge along the way, even for very technical topics. It might not develop further the actual theory, for example, but could reveal new ways to learn about it, interesting associations, interpretations, and more.

Focusing on such groups, “communities of practice”, Wegner (1991) uses an extended interpretation of the term “reification” to describe knowledge as a simplification of practice like “abstractions, tools, stories, terms, and concepts that reify something of that practice in a congealed form” (p.61), stressing that, another key concept, participation “is essential to repairing the potential misalignments inherent in reification” (p.64). His learning theory puts then a high emphasis on the duality between participation and reification, without going into very much depth on how reification actually takes place, and who is responsible for producing the abstractions of knowledge developed over time in a community of practice.

Traditionally, it was a key actor, the author, the scientist, the educator, the designer, the politician, the priest, the artist, the planner, the architect, who was responsible to collect information, to observe, to reify the collective social learning processes. It was dependent on the special qualities of this actor to what extent the final result was representative of the collective, whose only involvement in the abstraction process was to judge the way “their representative” has analyzed, interpreted and eventually reified, their individual contributions to the common pool of knowledge, through their participation in everyday life. Since the advent of the printing press, the opportunities for authorship have been becoming more and more democratized, making at the same time the peer evaluation mechanisms more and more critical. The peer review system in science is an example of a sophisticated peer evaluation mechanism between “authors” (Tennant, 2017).

Digital technology has made such peer evaluation processes of all types more and more expressive and accessible. Now derivative works, adaptations, memes, get created at a very fast pace, a process that is largely facilitated by the creative commons license. Multi-layered evaluation systems, where reviewers are also evaluated, are easy to implement, like the innovative online reputation-based review system of the Slashdot platform. Moreover, all types of knowledge abstractions can gain reputation and visibility (but unfortunately not credibility) by being “viewed”, “liked”, “voted”, or “shared”. Perhaps the most dangerous misconception regarding the digital platforms that mediate such p2p learning and evaluation processes is that they are neutral in their design and people are free to “like” and “share” what they want. The reality is that such platforms hide many biases that they are far from “random” but very carefully engineered toward manipulating their users according to the commercial and political objectives of the corporations that run them (Antoniadis, 2018).

Advanced digital tools allow also for unique in history modes of peer production of knowledge, like the co-creation of a single learning object, through collaborative editing, designing, making, coding.

Clearly, Wikipedia is the flagship p2p project in this context, an online encyclopedia edited freely by thousands of Internet users from who produced millions of articles. Tkacz (2015) provides a very comprehensive analysis on how Wikipedia's principles generate certain "frames" and "statements", which promote some views over others on which types of knowledge are legitimate, acting as a source of power in the conflict resolution process "from which the authority of commands can be established ('This is an encyclopedia, therefore Wikipedia Art must be deleted')" (Tkacz, 2015, p.85). Casemajor et al. (2019) provide another example through which they argue convincingly that the very design of Wikipedia, assuming its content is unconditionally "open", "categorized" and unidimensional, promotes a western mindset that is not compatible with indigenous culture. The question then arises. Why should someone insist on using Wikipedia and not simply create another platform based on the wiki technology with an appropriate design and rules?

The term "forking" has been established in the software programming word to describe this possibility, which often plays the role of a "liberogenic" device (Tkacz, 2015, p.136). The truth is that projects like Wikipedia cannot be easily forked in their entirety but smaller scale projects of the same type are perfectly possible and there are many examples of successful "forks" in the digital world like libreoffice, NextCloud, and many linux variants. But the choice to fork Wikipedia is not merely a technical one, as it is in the case of "stand-alone" systems like libreoffice or linux. Wikipedia is a socio-political system whose value goes beyond the personal consumption of knowledge. Indeed, the desire for one's perspective to be represented in a system like Wikipedia, is among others the credibility that this representation brings. However, this globalized and unidimensional knowledge is by construction limited and de-contextualized, and concerns mostly explicit than tacit knowledge.

One of the motivations behind our selected case studies was to bring back the focus to localities, and to help create learning processes that not only consume globalized knowledge but also produce local knowledge. For this it is important to add the "knowledge abstraction" part explicitly in the activities of p2p learning groups like the recent open call the Tzoumakers space to its members and supporters to reflect on methodologies for documenting the design of the tools designed and constructed in the lab. This action is part of the "design global, manufacture local" (Kostakis et. al., 2015; Kostakis et. al., 2016) mode of commons-based peer production where groups or individuals freely collaborate to design tools, share the knowledge as a global commons while building them locally with local conditions in mind.

It is only when the right balance between consuming global knowledge and co-creating local knowledge is maintained that many of the hidden power asymmetries can be reduced and learners become speakers. For this, platforms like P2PU and Openki should consider integrating in their design functionalities and processes that encourage collective knowledge abstraction, not only on the content itself but also on the p2p learning processes required for its appropriation and further development.

To this end, design blueprints, DIY toolkits, free software and patterns are very important knowledge abstraction devices that can help to create a balance between the global and the local. They could be seen as flexible seeds, developed as configurable prototypes or patterns at the global level through international networks of p2p learning, which then need to be carefully customized and planted in the local environment. As Christopher Alexander (1979) introduces his "pattern languages" in architecture, "It is the process which creates the organism---and it must be so. No thing which lives can possibly be made in any other way. If you want to make a living flower, you don't build it physically, with tweezers, cell by cell. You grow it from the seed."

# 5. Learning infrastructures

## 5.1 Digital infrastructure

Digital technologies have had an impact on different aspects of human life, including of course education. All three dimensions of the learning process discussed above can be facilitated with the use of digital platforms of different types. The more powerful these digital platforms become in storing, processing, and filtering information, the less critical appears to become the role of the teacher, the educator, the facilitator.

But as more power is moving from traditional actors to digital platforms, the more important it becomes to question how these platforms work and who owns, who designs and who controls them. There is abundant literature on the serious threats of the increasing dependence on digital technology, especially when it is big corporations that shape its functionality and exploit the immense amount of behavioural data produced toward commercial and political objectives.

For example, Cronin (2019) warns us that "the suppression of privacy lies at the heart of the business models of most digital and social media platforms–which rely directly on the appropriation of data for profit (Srnicek, 2016; Zuboff, 2015)". Most importantly, "many of the tools and platforms we use to engage in social connection and open educational practices have bias and inequality built into them –they are designed to allow and encourage forms of participation, and prevent others (Gilliard&Culick, 2016; Marwick,2013)".

The e-book edited by Williamson (2014) provides a comprehensive analysis of the critical role that software code plays in shaping educational processes, among others, and the hidden and dangerous biases that an algorithmic treatment of education, as manifested through "learning analytics", "automated learning" and other "smart" educational platforms, can impose on "users". The big question is, what can we do? How can we engage deeply with the reality of the Internet and the digital platforms running on it?

At the software level, free, libre and open source software provide a credible alternative to corporate platforms and infrastructuring in participatory design a powerful concept to visualize the co-creation for tools that are easy to appropriate toward real needs (Ehn, 2008). A lot of tools exist for the facilitation of asynchronous collaboration for making digital creations (e.g., GitHub, GilLab). Those tools are based on the experience of p2p digital collaboration, integrating features and practices that enhance the capability of communities to carry collaborative projects.

Openki.net is a platform built exactly with these issues in mind. Similarly, as noted by Grif Peterson (ibid), P2PU initially considered the use of MeetUp but this option was rejected because of the lack of trust that the project could scale in its own terms depending on such a platform. So, the P2PU team built their own tool for event management and a complimentary API. This offered to the learning circle communities a ready-to-go solution for running learning circles, without giving up the flexibility for people who are looking for a self-hosted solution.

Notice that software is only a part of the infrastructure required to run a digital platform. Community Networks (Dulong de Rosnay et al, 2019) are examples of networking infrastructures, including routers, antennas, and servers, which are owned and managed by local communities as a commons. Antoniadis (2018) proposes the concept of the "organic Internet" to describe such infrastructures stressing their capacity to be installed and deployed where the community using the corresponding software services is located. What is crucial in this scenario is that the co-creation of

the digital platforms designed to support p2p learning processes is itself a very emancipatory learning process about how the Internet works and why digital sovereignty is linked to fundamental human rights.

## 5.2 Physical infrastructure

Formal education includes in general a very well defined space where the learning activity takes place, the classroom. Peer learning processes, of the type promoted in this chapter also need spaces where people can meet to create learning groups, organize their learning processes, interact etc. Then the design and governance of those spaces also play a key role in the process, and they can also be more or less “peer-to-peer”, or better in this context commons-based.

The P2PU has developed a strong collaboration with public libraries, which are natural locations for learning activities, although mostly imagined as solitary places for study. More dedicated spaces for p2p learning around making and innovation are makerspaces, hackerspaces or fablabs (i.e. fabrication laboratories).There is a wide range of people that you can meet in these places: architects, designers, engineers, programmers but also woodworkers, machinists, hobbyists or just curious individuals. All of them engage in the process of learning by doing, often helping and collaborating to develop an idea into an actual physical or digital artefact (Sheridan et. al., 2014).

While the most prominent aspect in makerspaces is the final artefact, it is the social connections and interactions that frame the making and learning experiences which are of equal importance (Telhan et. al., 2016). In a makerspace, the learning process is not given nor is regulated (Halverson et. al., 2014). As Blikstein & Worsley (2016) mention, “novices coming into a maker lab need a considerable amount of onboarding and facilitation before they can start “hacking” and learning by themselves” (p.71). However, in reality preconceptions on social groups that are not considered “technology people'' (ibid) lead often to self-exclusion and indeed well-educated, affluent, white males are by far the main actors (Halverson et al., 2014).

Tzoumakers is a commons-based peer production community initiative that connects small-scale farmers with global similar communities under the aim to collaboratively design and manufacture open source tools for their work. In terms of governance, space rules are formed from both the local rural community, the P2P Lab research collective that initiated this project, the local municipality that offers the building and, for the first years, from the Interreg EU project that funds a number of its activities. Does this reflect on the learning processes that take place? Of course it does, as p2pness consists of a mixture of typologies involving learners, facilitators and experts in a space that incorporates functional characteristics from all the formal or informal bodies that constitute this special makerspace.

Notice that in the case of makerspaces, the p2p learning process is always anchored in the space itself which serves as the focal point of the corresponding community of practice. The same holds for the case of learning circles that in most cases are anchored in libraries. In the case of Openki.net the matchmaking platform is the focal point and physical space is seen as a flexible infrastructure which can be offered by one of the participants. The idea that p2p learning activities can take place in any urban space, indoors or outdoors, as part of everyday life, increases a lot the target audience and the overall impact. Seen from this perspective, L200 is a collective space in Zurich, which tries to combine these two perspectives.

On the one hand, L200 is a very central space that acts as a focal point, between a wide community of citizens that participate in its governance as a commons and its sustainability through cost sharing. On the other hand it explicitly avoids creating a specific identity for the activities through a sustained effort to make the space as inclusive as possible, open to always new and unexpected

uses. Placing the question “What is this?” prominently in the space’s facade is indeed to remind that failing to keep the space neutral and open to all types of usages would be against its main goal. The L200 project is also interesting because it is perceived as a hybrid, digital and physical, space designed as a prototype whose success depends on its ability to replicate (its core identity, even its name is defined by its location, its address, Langstrasse 200). Through such design choices the message is clear that “forking” is not considered as an “exit strategy” that helps to build “consensus”, but as a necessary step for transforming p2p learning to an everyday activity.

# 6. Conclusion

In times when digital technology has been promoted by the industry and governments as a game changer for enabling p2p learning beyond borders and constraints (Cronin, 2019; Deimann & Peters, 2016; Knox, 2016; Williamson, 2015; Benkler, 2006), we highlight the irreplaceable role of face-to-face interactions and the conditions under which technologies can play an empowering role. Although technology still has an important role to play, it brings many threats and more layers of power imbalances, in addition to race, gender, culture, class, location, sexuality and other structural inequalities. When all these are analyzed in detail make the concept of peer-to-peer to look more like an utopia than a realistic goal. But, instead of getting paralyzed by the impossibility of a truly egalitarian and p2p way to learn together, we advocate for a continuous effort to engage with p2p learning in everyday life, in the “neighbourly community”, even when this seems extremely difficult. The aim is to use technology as a means and as a complement, not as an end. For example, local communities can co-produce global knowledge, share it openly and thus empower other communities to adequately adapt and address their needs without imposing external values on them.Our selected case studies are examples of the type of tools and institutions that we believe can help in this direction.

We would add to this toolbox of p2p learning “reflection in action” which acknowledges our “capacity for reflection on our intuitive knowing in the midst of action and, sometimes uses this capacity to cope with the unique, uncertain, and conflicted situations of practice" (Schön 1983, pp.viii-ix). Pettit (2006) argues similarly that “understanding and addressing power, calls for more innovative learning processes, [...] the conceptual and rational re-evaluation of one’s assumed perspective [...] making sense of one’s experiences of power, and of realising one’s capacity to shift power.” Ending then with a self-reflection exercise, we would like to highlight the fact that works like the Handbook of Peer Production, full of arguments and analyses on the benefits of openness and collaboration, is distributed behind a paywall. Of course, there are no easy solutions. But perhaps we should take a moment to think about why so many intelligent people criticising the current publishing industry have not found a more open and p2p way to publish their work and still being respected in their professional circles.

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# Short Bios

Panayotis Antoniadis is the co-founder of NetHood, a Zurich-based non-profit organization that combines research and action in the development of tools for self-organization and conviviality, bringing together different forms of commoning in the city like community networks, complementary currencies, and cooperative housing. http://nethood.org/panayotis/

Alekos (Alexandros) Pantazis is a Core Member of the P2P Lab, an interdisciplinary research collective focused on the commons, and a Junior Research Fellow at the Ragnar Nurkse Department of Innovation and Governance, Tallinn University of Technology. Moreover, Alekos has 20 years of involvement in international civil movements, focusing on agrarian indigenous populations and the commons. He is pursuing a PhD on the convergence of convivial technologies, commons and non-formal education.

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# Curriculum vitae

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**Education**

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| 2016–2021 | Tallinn University of Technology – PhD in Technology Governance. |
| 2009–2010 | School of Pedagogical and Technological Education – Certificate of Pedagogical and Teaching Competence. |
| 2004–2006 | National Technical University of Athens – MSc in "Nautical and Marine Technology and Science". |
| 1999–2004 | Technical University of Crete – B.Sc. In Environmental Engineering. |

**Language competence**

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| Greek | Native |
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**Professional employment**

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| 2014–2015 | Freelance Marine Researcher – Crete, Greece. |
| 2010–2014 | Freelance Environmental Educator in Kindergartens – Crete, Greece |
| 2010–2011 | Environmental Educator – Center of Adult Education of Rethymno, Ministry of Education of Greece – Crete, Greece |
| 2008–2009 | Coastal Zone Management Lead – NGO Mediterranean SOS Network – Athens & Elefsina, Greece |
| 2008–2008 | Marine Environmental Engineer – National Centre of Environment and Sustainable Development – Athens, Greece |
| 2008–2008 | Marine Environmental Engineer – Department of Sea Sciences, University of Aegean – Lesbos, Greece |
| 2007–2008 | Marine Environmental Engineer – Foundation for Research and Technology, Institute of Applied and Computational Mathematics – Crete, Greece |

# Elulookirjeldus

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| 2004–2006 | Ateena Riiklik Tehnikaülikool – teadusmagister, merendus- ja meretehnoloogia ja -teadus |
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**Keeleoskus**

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| 2008–2009 | Rannikualade haldusjuht – MTÜ Mediterranean SOS Network – Ateena ja Eleusis, Kreeka |
| 2008–2008 | Merekeskkonnatehnoloog – Riiklik Keskkonna ja Kestliku Arengu Keskus (NCESD) – Ateena, Kreeka |
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