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List of Publications

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

- I **Pantazis, A.**, & Priavolou, C. (2017). 3D printing as a means of learning and communication: The 3Ducation project revisited. *Telematics and Informatics*, 34 (8): 1465–1476. **ETIS 1.1.**
- 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.**
- IV **Pantazis, A.** (2020). Teaching commons through the game of musical chairs. *TripleC: Communication, Capitalism & Critique* 18 (2): 595–612. **ETIS 1.1.**
- V Antoniadis, P., & **Pantazis, A.** (2021, in press). P2P Learning. In O'Neil, M., Pentzold, C. & Toupin S. (Eds.), *The Handbook of Peer Production* (pp. 197–210). New York: Wiley-Blackwell. **ETIS 3.1.**

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).

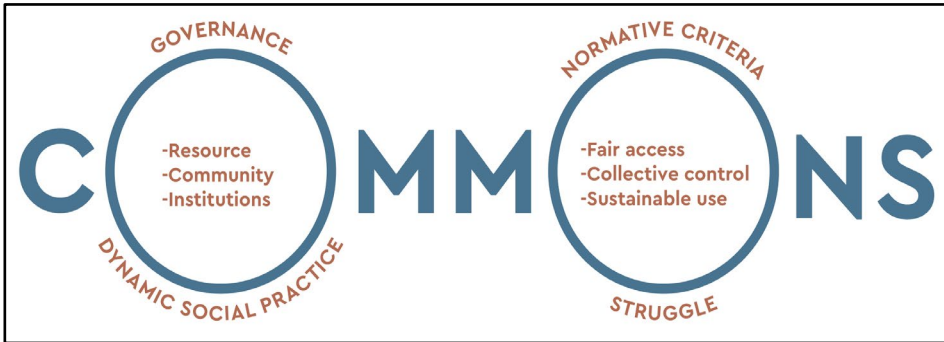


Figure 1: The commons as dynamic social practice and struggle (Source: Author, based on Tomašević et al., 2018)

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 exercised 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 (Kiwani, 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 Lissoy (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 Kioukiolis (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 Kioukiolis (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 Kioupiolis, 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 education¹ 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 inspirational 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.

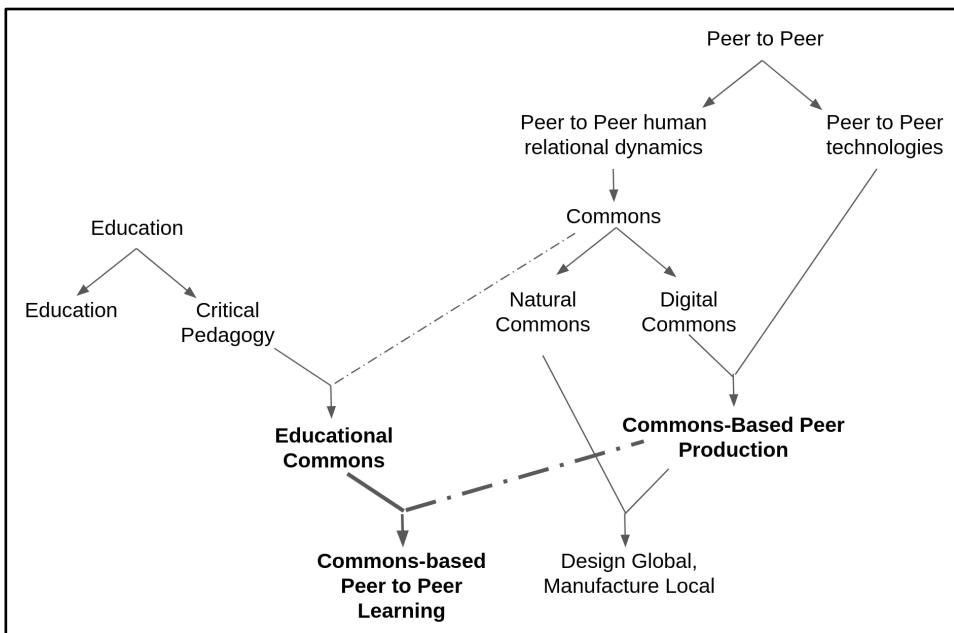


Figure 2: Illustration of the thesis contribution for commons-based P2P learning (Source: Author, based on Means et al., 2017; Kostakis & Bauwens, 2020)

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 Paysan⁴ 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 community⁵. 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; Cosmolocalism; 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 inspirational, 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 peers⁶. 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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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 potentsiaalst hoolimata on suur osa üle maailma eksisteerivate ühisvara jagavate kogukondade koostöö- ja õppetavatest 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 vaatab 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

Pantazis, A., and Priavolou, C. (2017). 3D printing as a means of learning and communication: The 3Ducation project revisited. *Telematics and Informatics*, 34 (8): 1465–1476.

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Publication V

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