



ITALIAN JOURNAL OF SOCIOLOGY OF EDUCATION

Editor-in-Chief: Silvio Scanagatta | ISSN 2035-4983

Towards a High Frequency Education: Challenges and Possibilities

*Stamatia Portanova**

Author information

* Department of Human and Social Sciences, L'Orientale – University of Naples, Italy.
Email: sportanova@unior.it

Article first published online

July 2021

HOW TO CITE

Portanova S. (2021). Towards a High Frequency Education: Challenges and Possibilities, Italian Journal of Sociology of Education, 13(2), 219-240.

DOI: [10.14658/pupj-ijse-2021-2-10](https://doi.org/10.14658/pupj-ijse-2021-2-10)

Towards a High Frequency Education: Challenges and Possibilities

Stamatia Portanova

Abstract: Drawing on a critical review of the relevant trans-disciplinary literature, and combining it with the method of auto-ethnography, this paper analyzes the sociocultural impact of distance learning. The aim is to highlight how, in the age of ‘post-education’ (Serpieri, 2020) and of ‘platformized’ educational institutions (van Dijck, Poell & de Waal, 2019), we are witnessing an intensification of screen-based discipline, but also a parallel explosion of creative potential, in pedagogical processes. This two-way transformation of educational systems will be here defined as the emergence of a new ‘edu-rhythm’, bearing in mind Alfred N. Whitehead’s philosophy of education (1947), and its focus (much before the advent of e-learning technologies and social media) on the organic rhythm of education as the gradual growth of a teaching/learning cell, a process characterized by different developmental phases and by an alternate need for disciplined attention and free distraction. Following this line of thought, the paper proposes to think the physical and mental performativity induced by contemporary platforms (between attention and distraction, or between the relative speed and slowness of teaching and learning) together with the autonomous performativity of algorithms, in order to understand the social and cultural transformations of education in terms of a new cybernetic rhythm.

Keywords: distance learning, attention, rhythm, algorithms

Introduction

Microsoft Teams arrived as the official educational platform of the academic institution where I teach, the Università degli Studi di Napoli 'L'Orientale', after a first moment of heeling and surprise caused by the Covid-19 pandemic spread. In the meanwhile, under the influence of a creative push that was starting to produce a certain level of technological experimentation, some of us had already organized ourselves, and had begun using various digital tools in order to prepare our first distance lectures. For example, I started by using the preexisting Moodle platform, and by creating and uploading Power Point slides with embedded video links and audio comments, and ended up mixing up my lectures between words, sounds, music, with the aid of the open source musical composition software Audacity.

The present contribution focuses on the topic of distance teaching and learning, and on the transfer of educational activities online. The aim is to provide for a critical survey of some of the theoretical discussions about the sociocultural transformations of educational practices and contexts through distance teaching and learning. In particular, the essay also develops a critical theoretical reflection on the transformation of the sociocultural experiences of teaching and learning, provoked by that «complex interplay between technical architectures, business models, and mass user activity» which is defined by van Dijck and Poell as the 'platform society' (van Dijck & Poell, 2018, p. 579). The discussion would like to highlight how, in the age of 'platformized' education and of 'post-education' (Serpieri, 2020), we are witnessing an intensification of screen-based bodily discipline and digital control, an increase in datafied populational regulation and behavioral codification, but also a parallel explosion of creative potential, in pedagogical processes. This two-way transformation of educational systems, and of the subjectivities involved in them, will be here defined as the emergence of a new 'edu-rhythm', bearing in mind Alfred N. Whitehead's philosophy of education (1947), and its focus (much before the advent of digital technologies and social media) on the organic rhythm of education as the gradual growth of a teaching/learning organism, a process characterized by different development phases, and by an alternation between disciplined attention and free distraction. Drawing on this theory, we can trace the contemporary version of this educational rhythm as it is emerging across the virtual rooms of various online platforms.

Educational platforms appear as the instantiation of a technologically enabled form of 'social production', in which the necessary resources are assembled both in and outside of institutional structures. In this sense, these platforms can in fact be understood, using Tiziana Terranova's words (2018), as a further modality of capitalist surplus value production through the con-

stant upgrade of a parceling technical system of information exchange, and through the building of an (often discriminatory) data infrastructure for the monitoring of attention/study/success rates. And yet, according to Terranova, social production also appears as a simultaneous materialization of common and autonomous affects and desires among the different components of the platform, a network where contagious ideas can spread free from institutional requirements. Furthermore, according to Luciana Parisi (2019), the automation of the intellect does not simply imply the subsumption of sentiments and ideas through a new rationalization of social thinking, but involves the performative activity and sociality of algorithms themselves. As argued by Parisi, cognitive capital seems to have turned the subsumption of the 'general intellect' (and thus of social intelligence or social production) into a crowd of algorithms autonomously and efficiently behaving or even driving decisions (such as when data analytics is deployed for the development of predictive models to improve students' or institutions' success). In the new algorithmic governance of education, software becomes in fact a key participant, or an automated 'social actor', a new component of the organism, that is increasingly often involved in the restructuring and monitoring of pedagogical actions and behaviors (Williamson, 2013).

In this essay, the proposal is to think the physical and mental performativity that is emerging on contemporary educational platforms (between attention and distraction, or between the relative speed and slowness of teaching and learning) in synch with the performativity of algorithms. Here, the notion of algorithmic performativity, like that of algorithmic power in T. Bucher's words, "may not even be about the algorithm, in the more technical sense of the term," but about "the kinds of encounters and orientations algorithmic systems seem to be generative of" (Bucher, 2018). The final aim of such focus on algorithmic performativity will be to understand the social and cultural transformations of education in terms of a new cybernetic tempo, or rhythm.

Literature Review

Speaking on a general level, it is easy to see how the contemporary world is increasingly ordered and arranged by 'algorithmic power' (Beer, 2009) and regulated by the 'governing algorithms' (Barocas, Hood & Ziewitz, 2013) that are written in computer code. The relevant critical literature on the presence, action, and influence of algorithms in most social processes and contexts, in fact, often focuses on the notion of 'code'. In the so called 'platform society', code, it is said, discursively «transforms and reconfigures the world in relation to its own systems of thought» (Kitchin & Dodge, 2011, p.44). Since all software and computer technologies require code to operate,

the latter needs to be understood technically (pieces of code providing instructions on how to proceed from an input to the production of an output), but also as «an expression of how the world can be captured, represented, processed and modelled» in order to «enact knowledge about the world» and «to augment, mediate and regulate people's lives» (ivi, p. 26). As Kitchin and Dodge argue, code has become «a vital source of social power» that increasingly «augments and automates society» (ivi, p. 246). Williamson (2014a) proposes to consider this process in terms of what Michel Foucault defined as 'the encoded eye', that is the kind of pre-established grids of classification and understanding which we apply to our perception of things in our everyday lives. Bowker and Star make similar arguments about systems of classification, standardization and categorization as largely invisible organizing forces that 'sort out' the social and moral order we live by (Bowker & Star, 2000). Computer code now stands in for the encoded eye; it provides a grid of perception and social systems of conduct that significantly shape how people think and act.

Being not inert but performative, code performs its work by changing an input from one state to another, through sequences of commands and processing operations, mostly in an autonomous way. The significance of this procedure in terms of governance, derives therefore from the fact that it can 'make things happen' by virtue of its 'execute-ability', or its ability to perform tasks according to encoded instructions (Mackenzie & Vurdubakis, 2011, p. 6). According to Williamson, its social executability, its power of governing, and its diffused presence into everyday life and systems of thought, have allowed code (including the algorithms it enables and the software it instructs) to also become a crucial social actor in the shaping of educational processes and institutions, «justified and naturalized discursively as a seemingly common sense solution to a whole range of educational problems» (Williamson, 2014b, p. 87). From the use of electronic attendance registers, the growth of educational technologies and the use of commercial management and administration tools, to the collection and analysis of learners' performance data through various platforms and algorithms, code can now be seen as mediating, augmenting, and co-producing pedagogies, curricula, policies and modes of governance in the educational context through its quantitative logics. Williamson's central argument (2014a) is that techniques and discourses of 'governing by numbers' are being augmented with techniques and discourses of 'governing by code'. Where governing by numbers utilized statistical instruments, measurement techniques, and the discourse of comparison, governing by code depends on sophisticated software instruments (especially networks and databases) which, instructed by code, have the 'algorithmic power' to participate as policy actors in public education.

After recognizing the social power of software and its code, what potential identity formations, Williamson asks, can we see as being promoted by the pedagogical practices and discourses made possible by the codified, network-based and data-driven digital governance of education? Much of the computer code acting or performing in education in fact embodies and materializes existing worldviews. Taking as his object of study the software and data infrastructure implemented by Higher Education in the UK, Williamson stresses the latter's emphasis on student choice and the vision of education as a competitive marketplace of providers, together with increased performance measurement, improved outcomes, and future productivity for the economy. «In particular, data infrastructures simultaneously realize the utopian project of making smarter digital universities while also reshaping the HE sector through the political project of market reform. In this sense, data infrastructure constitutes a hidden architecture for marketization in Higher Education» (Williamson, 2018, p. 1). Williamson's point of view on a data-driven, software-based education seems to indicate that not only the quantitative logics, but also the technological affordances involved in all the most recent transformations of the academia (ie the transfer of most teaching methods and learning activities on online platforms), can (and should) be intended as following a unique market-oriented direction. This vision coincides with van Dijck *et al.*'s definition of a 'platformized education' (2018) as an ecosystem of practices that are not only economic and technical but also sociocultural. These practices include the proliferation of private educational platforms, but also the selling, by the Big Five tech companies, of hardware and software apparatuses (such as the Microsoft Teams platform) to schools and universities. According to the theorists, the main sociocultural mechanisms at work on these platforms (mechanisms that are defined by them as 'datification, selection and commodification') significantly modify the values and principles of education, taking them towards a neoliberal direction.¹

In this critical theoretical landscape, a specular point of view is also emerging from essays and papers published on and offline, but also from social media posts and blog entries, as an opposite, instrumental perspective which is more focused on the functional revalorization of distance teaching and learning tools, and which sees the latter's many possibilities as a 'cornucopia of options' with positive practical effects, and with capacities for supporting, assisting and improving the processes and results of learning. (Giancola *et al.*, 2019, p. 464) From this perspective, the usefulness of such tools goes from «the capacity for shifting the time and place of the educational interaction» as a valued source of flexibility (Anderson in Rapanta

¹ A similar research direction is taken by Adamson, Åstrand and Darling-Hammond, in their edited collection of the analyses of various national education reforms (2016).

et al., 2020, p. 925), to the possibility of transforming teaching into a real design process influenced by both product-oriented and process-oriented aspects of strategic planning (Goodyear, 2015), while at the same time including more materials and more media formats into the design. The definition of Networked Collaborative Learning is another interesting conceptual and practical proposition that describes «the bringing together of learners via personal computers linked to the Internet, with a focus on them working as a ‘learning community’, sharing resources, knowledge, experience and responsibility through reciprocal collaborative learning» (McConnell in NLEC, 2020, p. 4). Distinguishing itself from definitions of distance learning that undermine human connectivity while reducing education to the production, delivery and consumption of content (‘online materials’), the notion of NCL emphasizes instead interpersonal connections, focusing on the way «in which [information and communications technologies are] used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources» (Goodyear, Hodgson & Steeples in NLEC, 2020, p. 5). Among the other main positive aspects often highlighted by both students and teachers, we can list the detachment of lectures from the environmental constraints of physical rooms (eg inadequate dimension, spaces too big or too small), but also the immediate accessibility of contents, resources and support materials, and the possibility of interacting through chats and video calls.

In line with Giancola, Grimaldi and Romito’s reflection, this essay would like to intervene in the critical debate on the relationship between education and new technologies, while following their suggestion “to avoid the pitfalls of ‘technological optimism’” and “the a priori rejection of ICT and digital technologies” (Giancola *et al.*, 2019, p. 463). Overcoming the contingent connection between the emergency of the Covid 19 pandemic explosion and the adoption of digital technologies for teaching and learning, these kind of reflections place platformization at the very heart of that process of restructuring which HE systems have now been undergoing without really managing to escape a simultaneous condition of permanent crisis and of unprecedented potential. In this two-way scenario of criticality and positivity, or of fear and hope for the digital future of education, there is a particular question that does not seem to have appeared anywhere: what if we looked at the algorithms working on educational platforms not only in their instrumental utility (the inert tools of self-discipline and governmental control, or of personal creativity and collective collaboration), but as collaborators themselves? Will these collaborators always be complicit with neoliberal ideologies and power? Or will they manifest their own possibilities, their own capacity to influence us, even their own ability to surprise us? In the theoretical literature on ‘smart universities’, one of the main critical points emerg-

ing is indeed that «data infrastructures are not just technical programs but practical relays of policy objectives to reform the sector» (Williamson, 2018, p. 1). While Williamson's thoughts appear as extremely useful for an analysis of the preexisting objectives encoded in the technical and sociocultural architecture of platforms such as Microsoft Teams, this essay would like to add a further question to the statements provided by Williamson's research: do we really have to leave the bodies and minds of students, of teachers, but also of algorithms, in this docile status? Could not we collaboratively learn 'with' the machine, while trying to deviate from some of the social norms and values embedded in it?

Some of the theoretical reflections about the sociocultural significance of educational digitalization are showing us that, perhaps, this further perspectival shift is already happening. According to Serpieri (2020), for example, the self-care practices that are automatically integrated in the use of Social Networking Sites (and, we might extend, of educational platforms) continuously form, but at the same time also offer us new possibilities of transforming, our subjectivities, because of the ethical concern for the governing of ourselves and the others. From this point of view, algorithmically encoded practices such as that of writing a diary (when posting or tweeting, but also when uploading images and videos, or when writing comments), or of performing (when adapting one's look, posture, motion, speech, to the constraints of the webcam), open up spaces for an ethical governance of the self. This continuous auto-exposition triggers a process of subjectivation involving, in Boccia Artieri's words (Boccia Artieri *et al.*, 2017), 'other significatives' that are always fragmented, volatile, and plural, generating a sort of innumerable alterity of the self. A 'plural subjectivation' that, on the one hand, easily falls into a neoliberal modelling (for example when, on an educational platform, continuous comments and questions to the teacher are used to build the image of an efficient student model); but that, on the other hand, also leads towards a disruptive 'improvisation', the emergence of a new self. For this reason, the neoliberal model and definition of education here proposed corresponds to what Serpieri defines as a form of 'ethical governance', where individuals are left free to surf between 'adhering' and 'autonomous' forms of subjectivation.

It is important to note that the relational nature of these writing and performing practices, 'transmedia skills' and 'informal learning strategies' (Tirocchi & Taddeo, 2019) necessarily implicating the subject in a transformative connection with its 'other(s)', is simultaneously and deeply intertwined with the performativity of algorithms. For example, the LinkedIn algorithms giving more visibility to short, even one sentence paragraphs; or, on Microsoft Teams, the videoconference algorithms deciding the criteria for users to remain visible onscreen during a call. In this sense, algorithms

cease to be the merely functional tools that allow us to perform various tasks corresponding to preconceived social and cultural norms, in order to become tightly, intimately embedded in the formation of our identities, perceptions, thoughts and behaviors. The political value of this tight cybernetic relationality is also profoundly ambiguous, and has been so far discussed from different perspectives. In short, the main paradox is that while, on one hand, the technologized subjectivations and relational abilities released by post-Fordism and, even more, by the postdigital functions integrated in SNSs and platforms, become crucial components in the market-based production of value, these very functions, on the other hand, retain an autonomous potential which (as shown, among others, by Serpieri, Boccia Artieri and Terranova) is not exhausted or captured in advance by marketization. Drawing on post-workerist Marxists, Terranova (2018) in fact argues that this potential constitutes the (virtual) engine of a post-socialist and post-capitalist common, a co-poietic production which holds together the collective, the singular and the machine. As indicated by S. Tirocchi and G. Taddeo (2019), the skills and strategies acting as virtual engines of post-digital education should be valorized, in order to overcome the mainstream idea of digital education, and to place the relations between teachers, students 'and' machines (here intended as platforms, or performative intermediaries between users and algorithms) at the center of the educational processes.

Methodology

Being a university teacher, I was able to experience these transformations in the first person, thanks to my participation in the accelerated platformization of academic courses (as of many other activities and practices of ordinary life) that followed the explosion of the Covid-19 pandemic crisis and the subsequent lockdown of everyone and everything. From a methodological point of view, therefore, the discussion will also approach the genre of autoethnography: that is, according to Anna Lisa Tota (2018), a particular genre that allows the researcher to make her theoretical reflections and critical interpretations derive from a basis of personal experiences which are certainly not generalizable, but which nevertheless present the salient characters of a cultural experience. This experience will then be analyzed through the conceptual tool of 'edu-rhythm'.

At this point, one thing needs to be pointed out, about the possibility of autoethnography in the post-Covid-19 sociotechnocultural landscape. The definition of 'personal experience' in itself clearly indicates the simple fact of being present in the observed context or event. Now, at the very moment in which these pages are being written, almost eight months have passed since the initial declaration, by the Italian government, of an immediate

stop for all public and private activities ‘in presence’. And even now that the general lockdown has finally been suspended, it is still on for almost all academic and, more in general, all educational work (while discussions about the option of ‘blended learning’ are currently being held by various public and private institutions). During these months, I have therefore had the possibility to not only observe, but to actually ‘live’, the impact of digitalization on my own teaching methods, ideas, practices, and to observe the learning experiences of my students. But it has been, as Sherry Turkle would already say in 1995, a ‘life on the screen’. The main consequence of this situation (and, more widely, of any digitalization, datification and internetization process) is that the sense of terms such as ‘experience’ and ‘presence’ should be (and is actually being) rethought. Focusing on the relational nature of the online experience, Giovanni Boccia Artieri et al. (2017) for example highlight how the notion of ‘proximity’ is not constrained by the spatial dimension anymore, but becomes associated to a new spatio-temporal closeness to others. As Boccia Artieri has recently argued, the real challenge, for the future, will therefore be to confront ourselves with new concepts of ‘presence’ and ‘interaction’, involving both online and offline bodies, through a unique didactic approach that should keep them together in different places but at the same ‘time’.

This essay will try to incorporate such rethinking into its autoethnographic body, and to develop a post-digital modification of that particular type of autoethnography that Luigi Gariglio defines as ‘evocative’ (that is, an ethnography that is mostly based on personal, almost confessional, accounts by the researcher)². In particular, Gariglio’s conception of the auto-ethnographic evocation highlights the character of ‘experimental reflexivity’ that differentiates this method of research from what Arthur Bochner defined as ‘empirical orthodoxy’. The main distinctive trait of evocative auto-ethnography resides in its openness to heterogeneous approaches: by proposing a plurality of methods instead of binding guidelines, it is able to welcome postmodern philosophical approaches and creative writing styles among its techniques, and to include written and visual recordings of its research. My autoethnographic storytelling will therefore include, together with a written report of ‘my’ and ‘their’ feelings and emotions, images of the various traces left by them online. The description and comment of this material will act as a sort of ‘diary’, to be transformed into a study of the

² For the difference between ‘evocative’ and ‘analytic’ autoethnography, see Gariglio, 2017, and Chang, 2008. Bochner and Ellis (2016) also describe ‘evocative auto-ethnography’ as ‘a way of life in the human sciences’ that aims at establishing an intellectual and emotional connection to the lives of readers, through the representation of one’s own lived experiences.

teachers' connection with students' across the online platform.³ At the same time, the story will not be a mere account of human sentiments and actions, but also of algorithmic principles and behaviours. As A. Goffey highlights, the algorithmic behaviour, or procedure, goes much beyond the machines and programming languages through which it is written: in this sense, an algorithm becomes an abstract code or procedure, which we can mainly come to know through its embodied, or materialized, existence: through the classifying order of databanks, through the software and programs we use to design a website, or through the platform on which we attend an online class (Goffey, 2008). It is in this materialized sense that, in this research, the algorithm ceases to be a methodological tool (the data provider and interpreter), to become an analytical object in the observational field. Some recent approaches and attitudes in sociological research are in fact already pointing towards the possibility of including 'material objects' (apart from human subjects and human objects of research) as protagonists of the social sphere. Beyond Graham Harman's Object-Oriented Social Theory (2016), Karin Knorr-Cetina (1997) has also focused on 'knowledge objects' ('tools' such as trading screens but also finance algorithms). Screens, for her, are a medium for social relations, as they attract us, project urgency, speed and power on us, while we feel their 'heat'. But the scopic regime represented by screens might in fact soon migrate underground, to that dimension of software and algorithms whose activity is, only for the moment, still (partially) overseen by humans. Together with Bruno Latour's Actor-Network Theory (2007), Knorr-Cetina's point of view indicates us an important methodological path, in which objects do not appear as passive receptacles for human mental or social categories, but actively mediate relations between human users: interactions, expressions, activities, are mediated by algorithms as social agents. What about educational platforms and the algorithms that inhabit them? Can they also be observed under this materialist, action-oriented light?

Rossella Landriscina and Assunta Viteritti's study of sociomateriality in the classroom (2016) marks an interesting shift in the conception and production of didactic innovation, associating to the gestures, postures and behaviours of human actors in the classroom, the active mediating or even limiting participation of material objects such as blackboards, desks, multimedia devices. A logical continuation of this approach would therefore reflect on the transformation of the physical space of the class into a digital platform, and the consequential entrance of algorithmic and datified objects in educational practices. What do algorithms do and make us do? How do

³ Auto-ethnographical research of platformized educational environments has also been undertaken, among others, by Lange, 2021, with relation to online tutoring software, as well as by Calzati, 2020, with relation to connective intelligence and social media networks.

they behave and what kind of interactions do they establish, among themselves and with humans? These might be some of the questions deriving from the digital transposition of Landriscina and Viteritti's argument into platformized education. In order to answer them, it seems of utmost importance to overcome the methodological distinction between algorithms and affordances, conceiving the pedagogical experience of the online classroom environment as the result of a technosocial assemblage.

In this specific case, the idea of an algorithmically mediated evocative auto-ethnography has been conceived as a direct consequence, and as a strategic result, of the emergency conditions established in the educational sector by the Covid 19 pandemic explosion. Nevertheless, this exceptional event has triggered teaching methods and pedagogical (self)reflections that have now been going on for several months, and that deal with issues of educational platformization and digitalization extending their influential sphere much beyond the emergency situation. Quoting Landri, Landriscina and Viteritti also highlight the renewed interest by many disciplines (including the social sciences) for practices rather than structures, and a subsequent ecological approach that distributes agency among human and non-human actors. It is under this light, that the following pages will try to explore one particular practice of platformized education (the teacher-students' chat) and to 'evoke' its pedagogical challenges and potentials, through a selected sample of chat instances that will serve as trigger points for a more in depth reflection on social and techno-material relationality.

Auto-ethnography

Emergency Covid 19 distance learning students were not aware, from the beginning of their new educational path, of the complex experience they would undergo for the following months. Rather than being conceivable as a straightforward, innocuous digital transposition of lectures and materials into an online course, distance learning reveals in fact all its real implications, and difficulties, only gradually along the path. The difficulties are multiple and complex, but from the perspective of the present discussion it should be highlighted that, in the first instance, this new modality requires that the students adapt themselves, and their different studying and learning tempos (or rhythms), to the constraints of a technological apparatus which combines videoconferencing and chatting tools, together with various posting and uploading instruments, for the delivery of lectures online. Beyond any excessively critical or enthusiastic rhetoric, it should be noted that this 'temporal' requirement can sometimes produce a very specific and concrete feeling of frustration, in those students who struggle finding the right timing for making an intervention during the lecture, for posing questions or com-

ments, and therefore for interacting with the teacher and their fellows, without interrupting the lesson flow in an abrupt or inappropriate way. This kind of frustration was not simply observed by me during my online classes, but also confirmed by the students of the two courses I taught in the academic year 2019-20: 'Media and Cultural Studies' (123 students) and 'Cultural and Postcolonial Studies of the Mediterranean' (101 students), as respectively part of the BA and of the MA degrees in Linguistic and Cultural Mediation at the Università degli Studi di Napoli 'Orientale'.

The following auto-ethnographic account thus tries to reveal the structure of the relational processes displayed in the techno-material settings of these two virtual classroom, following Landriscina's and Viteritti's research steps in the sociomateriality of the class, and substituting material object-mediated interactions with online algorithmic ones. (2016) To do so, the educational platform of choice was Microsoft Teams (the official teaching and learning platform adopted by the 'Orientale'), where live streaming of the lectures can be performed, accompanied by the possibility for students to interact with the teacher, either via direct audiovisual intervening or via written chat. A participant (self)observation of all the Teams practices was thus performed during the whole duration of the two courses (for a total of class 96 hours), with a particular attention for the teacher-student interaction modalities and temporalities. A sample of written teacher-students' exchanges during the lecture of April 19th has then been chosen and reported here, as illustrative of the main conceptual argument developed throughout the research. The sample will be here presented in written format, and will be used as point of departure to reflect on the new 'edu-rhythm' that is emerging in the post-digital age.

Immediately after the beginning of my two courses in the modality 'at a distance', I opened a Googledoc in order to gather student's comments, questions and ideas, in both modules. The aim of this document was to obtain, in an informal and unstructured way, the students' voice not through an organized questionnaire, but giving them an open space for reflection, with only very general hints and suggestions for thought. The students, in fact, reacted in what appeared to me, at that time, as an unexpected and surprising way, expressing emotions which, I felt, certainly deserved more attention. Mentioning various kinds of problems (from connection problems to the need of sharing the same PC among different family members), some of them also highlighted their reticence, when it came to expressing themselves through a web cam or even a chat, in inserting their image, voice, or writing, among the words of the teacher. The students, in other words, were revealing a difficulty in adapting their rhythm to the pace of a technologically mediated lecture. Only a few of them would in fact manage to cut out a time for speaking. In particular, it was the necessity of speaking one at a time

(a necessity that is in fact shared by both ‘distance’ and ‘in presence’ modes, but that is more acutely felt, it seems, in the digitally codified environment), that gave to them the impression of participating in shifts, rather than in a real dialogue. Despite the partial resolution of such difficulties through more focused seminars and group work, the impression of somehow being out of tempo still remained an interesting point to think about: too fast in the video/chat connection, too slow in the delayed forum discussions. Between teacher and students, time sometimes went out of joint. Or should we say, between teacher, students and machine?

Looking at the traces left by the students’ technorelational arrhythmia in one of my lectures’ chats, temporal slippages become literally visible, or readable, in the form of discrepancies between the topics of different questions posed by different students at the same time, and also deviating from the main content of the lecture. For example, the temporal disconnection and asynchronicity with the lecture’s timing often emerged, during the explanation of theories and concepts, in the form of questions about the technicalities of the course syllabus or the modalities of exams, in a way that would have obviously been unthinkable in presence. For privacy reasons students’ surnames have been omitted, and the names have been changed. The translations are mine:

[17/04 13:13] ANNA

Professor can I say something on a specific argument I found in the Stuart Hall documentary? (Professoressa potrei intervenire per quanto riguarda un argomento specifico trovato nel documentario su Stuart Hall?)

[17/04 13:13] MICHELA

I apologize about this technical question. But I would like to know if lectures will go on like this, because for me, at least today, this would be a problem, since I have also other lectures during this time slot. (Mi scusi, una domanda un pò tecnica. Volevo sapere se per caso le lezioni continueranno così, perchè per me almeno oggi sarebbe un problema dato che ho anche altre lezioni durante quest’orario)

[17/04 13:15] MARIA

I also have lectures that coincide with this one. (Anche io ho lezioni che coincidono con quella di oggi)

1 Like (1 Mi piace)

[17/04 13:16] VERONICA

Yes, in fact all those attending German II classes have their language lessons coinciding with your lecture. (Sì, in effetti tutti gli studenti di tedesco II hanno il lettorato che coincide con la sua lezione)

1 Like (1 Mi piace)

(...)

[17/04 13:24] LISA

I really wanted to know the relation between contemporary popular culture and SNSs and their content, and therefore memes and videos circulating on the web. (Mi premeva sapere il rapporto della cultura popolare contemporanea con i social e i loro contenuti, e quindi meme e video che circolano sul web.)

5 Likes (5 Mi piace)

[17/04 13:25] MICHELA

At least to do the lectures on the texts on Mondays. (per lo meno la lezione dei testi farla di lunedì)

[17/04 13:25] GIOVANNI

Hello professor, what is it that we can consider as NOT popular? (Salve prof, cosa può essere considerato NON popolare?)

[17/04 13:26] ANNA

Chinese III classes also coincide with this timing, teacher. (Anche la lezione di cinese III coincide con quest'orario, prof)

(...)

[17/04 14:09] LUDOVICA

Professor, I wanted to understand the link between cultural questions and political questions. (Professoressa, io volevo capire il legame che c'è tra le questioni culturali e le questioni politiche.)

[17/04 14:11] FRANCESCA

Professor I do not know whether this has been specified already, but is it possible to not accept the vote of the intercourse exam, and do the final exam with the addition of the 2 manuals? (Professoressa non so se è stato già precisato ma è possibile rifiutare il risultato della prova intercorso e fare l'esame finale con l'aggiunta dei 2 manuali?)

[17/04 14:14] ANTONIA

Professor and in this sense, what could be an example of contemporary culture in relation to this link? I am referring to the third question of the exam. (Professoressa e in questo senso, quale poteva essere un esempio di cultura contemporanea in relazione a questo legame? Mi riferisco alla terza domanda.)

[17/04 14:14] LUDOVICA

Yes professor, you have been very clear. Thanks a lot. (Si professoressa, è stata chiarissima. Grazie mille.)

[17/04 14:15] ILARIA

Yes professor. (Si professoressa)

The temporal gaps in the students' interventions were, on the other hand, experienced by me in different terms. The most apparently improper questions highlighted to me the necessity to slow down my pace, a necessity that was due to my difficulty in grasping, or sensing, the real level of the students' attention (a difficulty that is partially alleviated, in a 'physical' class, by reading various perceivable attention cues, such as students' gaze or yawning, the act of taking notes or of asking questions; but that is left totally unsolved by the transduction of the lecture's experience into the platform's algorithmic code). In particular, it is to be noted that the possibility of intervening during the lecture in a written format such as that of the chat (instead of activating the web cam in order to speak) made no real difference: sometimes, in fact, the students expressed the feeling of being more at ease with microphone and camera, than with suddenly starting to type while the teacher was speaking. It was of course very useful to alternate explanations with pauses and attention checks, but it is also to be noted that such moments had to be much more frequent than 'in presence': greater levels of distraction, if not of complete disconnection, were in short to be expected. It is also worth highlighting that, among the main causes of such disconnections, the students reported 'computer fatigue' by the end of a distance learning day.

Here, the *rhythmanalytic*⁴ perspective activated in this discussion interestingly connects itself to the sociocultural, but also economic, topic of attention. Attention, in fact, seems to be considered of high value, in a post-digital economic culture primarily based on the exploitation, for surplus value production, of autonomous, automatic and automated actions. More specifically, recent debates on the crisis of attention indicate the latter as a scarce, valuable commodity, at the same time producing the image of a cerebrally impoverished subject. The brain provides for attention as a scarce resource, while suffering an exhaustion of its own cognitive capacities. This concept seems to resonate with what Bernard Stiegler has called the «proletarianization of the mind's life» (2010, p. 21), which remains one of the possible results of the diffusion of digital and networked technologies. Yet, whether the reconfiguration of cognition provoked by digital technologies and platforms is to be valued as an impoverishment of attention, or as a more ambivalent mutation of subjectivity, is still an open question, from both a more specifically economic, and a more widely pedagogical and cultural point of view (Hayles, 2007).

⁴ Rhythmanalysis is here proposed as a perspective focusing on the analysis of social spaces as composed of different paces and velocities which affect the inhabitants of those spaces. It is in this sense that the technosocial space of the classroom is here intended as a rhythmic social space. The reference is to Henri Lefebvre's famous analysis of the rhythms of urban spaces, in: Lefebvre, 1992.

Some reflections on ‘edu-rhythm’ in the post-digital age

In a book entitled *The Aims of Education*, Whitehead argued (1947, pp. 45-46), already in the first half of the twentieth century, that as long as learning is considered as a mere acquisition of mechanical and utilitarian mental attitudes (or, in other words, as a memorization of the largest possible number of information units), educational activity cannot really progress, but only limit itself to the useless effort of a continuous re-systematization of curricula. In an apparent premonition of the formulations of contemporary scientists and economists, the philosopher/mathematician suggested that one should certainly consider the cognitive (and attentional) limitations of the human mind as an inevitable fact, but nevertheless reminding ourselves that it is exactly a certain «delightful ignorance» of important truths that makes the world interesting, while the arguments and notions to be learned and remembered will always be, in any case, too many (*ibidem*). From this point of view, the aim of education cannot be knowledge but wiseness, or more precisely, the way in which knowledge is managed, selected, and used to give value to experience. Since, Whitehead continued, the only way to obtain this wiseness is a certain freedom with respect to the acquired knowledge, and since the only way to acquire this knowledge is nevertheless a certain dose of discipline, it turns out that freedom and discipline are two equally essential moments, in what he defined as the rhythmic necessity of education (ivi, pp. 47-48), and in what I would like to define as ‘edu-rhythm’.

More specifically, the concept of ‘edu-rhythm’ refers thus to the fact that education is based on an alternation between the disciplined capture of attention, and the freedom to distract oneself. Together with the philosophical theorizations of Whitehead, this concept draws on the rhythm-analytical approach adopted by F. Dakka to critique the condition of the contemporary university, and particularly the experiences of the living bodies inhabiting it. (2019) To focus on the rhythmicity of the institution, in Dakka’s words, means to crack open the dimension of everyday academic activities (teaching, learning, researching) in order to find the points and spots where, from repetition and habit, differences and critical moments emerge that could enable a change. Through the analysis of rhythm, moments of disruption in fact appear through habitual repetition, together with harmonies and new forms of eurhythmia which, Dakka claims, could be very important in a time of diffused academic dysfunctionality. These woven patterns of movement and of social relationality make of the university a collective of bodies and minds: it is rhythm that allows us to connect with one another through a constellation of such emerging moments, as teachers and learners mutually engaged in space and time. Furthermore, by detecting moments of arhythmia, the rhythm-analytical perspective allows us to turn the symptom of a

disorder into a political weapon, in the stratified and commercialized environment of higher education. Connecting Whitehead's reflections on the rhythm of education with Dakka's suggestion of adopting rhythm analysis as an experimental transdisciplinary method for cultural research, the concept of 'edu-rhythm' here proposed becomes thus a useful tool to think about the temporalities, or rhythmic modalities, of the new forms of teacher-students' interaction on educational platforms. This perspective can allow us to reflect on, and to evaluate, the technological intervention in the relational dynamics of the classroom situation, from the point of view of an ecology of the collective body/mind.⁵

On one hand, the dilemma of yes/no to distance teaching and learning can evoke a conception of the educational moment as a more or less successful production and acquisition of knowledge, and of the mind as a box to be filled. From this perspective, the going online of lectures and other educational activities cannot but appear as a way to lose that attention that, being an already scarce commodity, should instead be entirely focused on the taught notions. Or, for the more pro-technology ones, as a way to usefully direct this attention on the innumerable notions that it is possible to find online. Differently from these two visions, in the «organic» conception of education formulated by Whitehead, we can distinguish three chronological phases not only in the whole educational epoch (respectively coinciding with childhood, adolescence and adulthood), but also in every single learning cycle (what is defined by him as an «organism», or a cell, an occasion of learning, in its completeness). A cell can therefore be not only a human learning brain, but also a single lecture, or a whole course. In the phase of childhood, or of «romance», freedom prevails on discipline, while the latter returns as the main necessity of the second phase, the phase of youth or of «precision», in order to finally give place to freedom again in the phase of adulthood, or of «generalization» (ivi, pp. 48-50). In other words, a learning mind can be thought not as a container but as a real organism that feeds and grows, with different rhythms and needs, and whose food is in fact also constituted by knowledge. In this gradual process of cognitive growth and development, thinking the possible entrance of information and communication technologies, and of algorithms, cannot be solved by the simple question of adding or subtracting knowledge, but has to be thought in the way in which they can (or cannot) insert themselves in the rhythm of that process, at their own pace.

In fact, discussing questions like attention deficit, concentration and rhythm in the educational context, one cannot avoid focusing on another

⁵ For a discussion on the relation between digital technologies, the ecology of the social brain, and the economy of attention, see Portanova and Terranova (2018).

challenge, constituted not only by individual exposure to the technologies of new media, but also by the contagious hyper-sociality of the connected brain (Terranova, 2018). Giving attention to what others, colleagues, fellows, friends do on social networks and educational platforms, produces what Terranova defines as 'a network culture'. This means that the conception of individual learning gives place to the more relational conception of 'prehension' (that is, for Whitehead, the way in which every entity of the real becomes a part of every other entity); and also means that units of learning or information are replaced by cells of prehensional feeling whose components, subjects, objects, starting data, final aims, are reciprocally implicated, in an intricate prehensive complexity. Let us therefore think again of our class discussion online: from the beginning of the lockdown, it was clear that while, in presence, there was a teacher who paid attention and managed the discussion, in the online case the mediating role was starting to be undertaken by the code, and by the chat algorithm itself, with its insensitivity to content, and its procedural responding in real time to every incoming input. Collaborating with this mediator implied not adopting its 'encoded eye', but paying more attention and care to its way of working and to the timing of others, so that to transform the educational platform, and its discussions, into a social networking experience. What is needed in schools, universities and, more in general, in places of education but also of production of social and cultural value, is therefore a further exploration of the ways in which the act of paying attention can produce different forms of subjectivity based on social cooperation between humans 'and' algorithms.

Conclusions

As a tentative conclusion, this essay would like to suggest that finding the right rhythm to navigate between the different temporalities of human cognition and of technological connection, could offer a possible productive way to think about the criticalities and potentialities of distance teaching and learning. The right rhythm is, of course, not intended here as a temporal law or a predetermined pace to be adopted in writing, studying or researching practices. On one hand, it is undeniable that the functioning of platforms and algorithms allows for more precise metrical measurements and quantifications of performances and, more in general, for a significant productive acceleration. The increasing reliance on data from teachers, students and institutions alike in fact seems to exclusively obey the common aim of working faster and more efficiently, with a consequent decrease in the capacity for qualitative attention and care. We could define this accelerated institutional temporality as 'high frequency education' (HFE), a concept derived from the definition of High Frequency Trading (HFT), ie "a subfield of algo-

rhythmic trading in which the execution of trades takes place at time intervals below the threshold of human perception. High-frequency algorithms can execute several hundred trades before a human can notice or react.” (Beverungen & Lange, 2018) The metaphorical transposition of this definition from the financial to the educational field seems to evoke, in the classroom situation, the same negative effects of velocity that have already been identified by traders as ‘costs of consciousness’ and ‘failures of cognition’. Yet, on the other hand, the paradoxical, ambivalent nature of HFE reveals many affordances that are still to be explored; such as when the automated, linear, sometimes obtuse chronology of a chat algorithm interrupts the flow of a frontal lecture, and generates a requirement for a different kind of attention, inducing the participants (both students and teachers) to concentrate on the words of others in a way that would be unthinkable in presence. The suggestion is therefore to try to collaborate, to work in synch, rather than use or be used by, this new technological rhythm. As a result of this perspectival shift, the vision of a post-educational cybernetic synchronization, is a synchronization between human teaching and learning performances together with those of algorithms and platform affordances, would cease to be the object of a sci-fi speculation or of an automation dystopia, to become instead the catalyzer of a rigorous yet creative attempt at pedagogical innovation.

The question of how to find a synchronized edu-rhythm in the post-digital context of HFE is, it needs to be said, an important ethical and political issue⁶. In this context, adopting a rhythmically deaf approach to the use of (often untested and untrusted) platforms and systems often leads to pedagogical practices that completely ignore the contextual conditions of the class situation, leaving a trail of anxiety and mental health problems. An interesting example of a counterpoint to this kind of deafness is offered by FemTechNet’s “Feminist Pedagogy in a Time of Coronavirus pandemic”⁷. The FemTechNet collective is, in fact, a network of scholars, students and artists who have developed and experimented with collaborative practices and technologies, such as the creation of an alternative to MOOCs called DOCC: a Distributed Open Collaborative Course, centred on science and technology studies from a feminist perspective. In their statement, one of the points to be noted is the discussion of the possibility of «asynchronous» learning, an educational format not exclusively based on real-time interaction, but on the availability of content online, in a way that allows students to access it according to their different schedules. Rather than conceiving the live co-presence of teachers and students as a demand, this possibility sees it

⁶ For a definition of the ‘post-digital’, see Nicholas Negroponte’s essay “Beyond Digital” (1998), available at <https://web.media.mit.edu/~nicholas/Wired/WIRED6-12.html>. See also Cascone, 2000.

⁷ <https://femtechnet.org/feminist-pedagogy-in-a-time-of-coronavirus-pandemic/>.

as an option «extended in the spirit of hospitality», giving, in this way, more attention and care to different learning situations and conditions. Although this notion seems to very much echo the ‘flipped classroom’ modality (ie the practice of digitally distributing teaching content that would be normally delivered in a lecture, and in turn construction of the assignment or home-work materials inside the class), the FemTechNet proposal is less tied to a precise or rigid schema of instruction, and more cented on the idea of a flexible adaptation of practices to continuously shifting situations. Not how to shape or be shaped, how to use or be used by code, but how to collaborate with it in order to create more inviting educational conditions.

Far from being a novelty in the landscape of platformized post-education, asynchronous teaching (and its blended versions) can nevertheless become, under the light of the concept of edu-rhythm that is here proposed, an interesting idea to be amplified. Under this light, educational approaches and practices can go in the direction of more rhythmic, open and caring alternations: between physical distance and presence, between distant access and real-time co-presence, but also experimenting with the notion of asynchronicity in the context of a single lecture. In the latter case, the notion of asynchronous edu-rhythm can trace for example interesting navigational paths between the extremes of a teacher-conductor that maintains a rigid seminar-QA structure, and a chaos of superimposed voices. The auspice is that a more rhythmic navigation among the possibilities of live speaking and listening, chat writing, real-time or postponed interaction, will lead to the work hypothesis of an aest/ethical pedagogy more attentive to human and also to technological, or algorithmic, contributions.

References

- Adamson, F. et al. (eds). (2016). *Global Education Reform: How Privatization and Public Investment Influence Education Outcomes*. New York: Routledge.
- Barocas, S., Hood, S., & Ziewitz, M. (2013). *Governing Algorithms. A Provocation Piece*. SSRN, March 29 2013. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2245322
- Beer, D. (2009). Power through the Algorithm? Participatory Web Cultures and the Technological Unconscious. *New Media and Society*, 11 (6), 985-1002.
- Beverungen, A. & Lange, A.C. (2018). Cognition in High-Frequency Trading: the Costs of Consciousness and the Limits of Automation. *Theory, Culture and Society*, 35 (6).
- Boccia Artieri, G., Gemini, L., Pasquali, F., Simone, C., Farci, M., & Pedroni, M. (2017). *Fenomenologia dei social network. Presenza, relazioni e consumi medialti degli italiani online*. Milano: Angelo Guerini e Associati.
- Bochner, A. & Ellis, C. (2016). *Evocative Autoethnography. Writing Lives and Telling Stories*. London: Routledge.
- Bowker, G.C., & Star, S.L. (2000). *Sorting Things out. Classification and its Consequences*. Cambridge US: MIT.

- Bucher, T. (2018). *If...Then. Algorithmic Power and Politics*. New York: Oxford University Press.
- Calzati, S. (2020). Digital Autoethnography & Connected Intelligence: Two Qualitative Practice-Based Teaching Methods for the Digital Humanities. *Umanistica Digitale*, 4 (8). Retrieved from <https://umanisticadigitale.unibo.it/article/view/9881>
- Cascone, K. (2000). The Aesthetics of Failure. "Post-Digital" Tendencies in Contemporary Computer Music. *Computer Music Journal*, 24 (4), 12-18.
- Chang, H. (2008). *Autoethnography as Method*. London: Routledge.
- Dakka, F. (2019). An Exploration of Rhythms in the Contemporary Academy: Time, Space and Affect. *Theory and Method in Higher Education Research*, 5.
- FemTechNet (2020). Feminist Pedagogy in a Time of Coronavirus Pandemic. Retrieved November 12, 2020, from <https://femtechnet.org/feminist-pedagogy-in-a-time-of-coronavirus-pandemic/>
- Gariglio, L. (2017). L'autoetnografia nel campo etnografico. *Etnografia e ricerca qualitativa*, 3, 487-504. Retrieved from https://iris.unito.it/retrieve/handle/2318/1679658/446731/Autoetnografie%20_Gariglio_preprint.pdf
- Giancola, O., Grimaldi, E. & Romito, E. (2019), La digitalizzazione della scuola. Temi, teorie e metodi di ricerca, *Scuola Democratica*, 3, 461-480.
- Goffey, A. (2008). Algorithm. In M. Fuller (Ed.), *Software Studies: A Lexicon* (pp. 15-20). Cambridge, MA: The MIT Press.
- Goodyear, P. (2015). Teaching as Design. *HERDSA Review of Higher Education*, 2, 27-50. Retrieved from <https://www.herdsa.org.au/herdsa-review-higher-education-vol-2/27-50>
- Harman, G. (2016). *Immaterialism. Objects and Social Theory*. Cambridge UK: Polity.
- Hayles, N. K. (2007). Hyper and Deep Attention: The Generational Divide in Cognitive Modes. *Profession*, 13, 187-199. Retrieved from <http://digitalrhetoricandnetworkedcomposition.web.unc.edu/files/2016/01/hayles-hyper-and-deep-attention.pdf>
- Kitchin, R., & Dodge, M. (2011). *Code/Space. Software and Everyday Life*. Cambridge US: MIT.
- Knorr Cetina, K. (1997). Sociality with Objects. Social Relations in Postsocial Knowledge Societies. *Theory, Culture and Society*, 14 (4), 1-30.
- Landriscina, R., & Viteritti, A. (2016). Sociomaterialità in classe. Pratiche di innovazione didattica. *Scuola democratica*, 1, 93-116.
- Lange, J. (2021). Platform Stabilization: an Autoethnographic Exploration of the Multiple Relations and Role of Data behind the Interface of Online Tutoring Software. *Critical Studies in Education*, 62 (1), 82-96.
- Latour, B. (2007). *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford: Oxford University Press.
- Lefebvre, H. (2004). *Rhythmanalysis. Space, Time and Everyday Life* (S. Elden, Trans.). London: Athlone. (Original work published 1992).
- Mackenzie, A., & Vurdubakis, T. (2011). Code and Codings in Crisis: Signification, Performativity and Excess. *Theory, Culture and Society*, 28 (6), 3-23.
- Negroponte, N. (1998). Beyond Digital. Retrieved November 12, 2020, from <https://web.media.mit.edu/~nicholas/Wired/WIRED6-12.html>
- NLEC (Networked Learning Editorial Collective) (2020). Networked Learning: Inviting Redefinition. *Postdigital Science and Education*. Retrieved from <https://link.springer.com/article/10.1007/s42438-020-00167-8>

- Parisi, L. (2019) Critical Computation: Digital Automata and General Artificial Thinking. *Theory, Culture and Society*, 36 (2), 89-122.
- Portanova, S. & Terranova, T. (2018). Cervello sociale, apprendimento ed economia dell'attenzione nella cultura digitale. In R. Serpieri & A. Tota (Eds), *Quali culture per altre educazioni possibili?* (pp. 81-100). Milano: Franco Angeli.
- Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Science and Education*, 2, 923-945. Retrieved from <https://link.springer.com/article/10.1007/s42438-020-00155-y>
- Serpieri, R. (2020). Tras-formazione dei sé: soggettivazioni social nella post-education. *Sociologia della comunicazione*, 59, 40-61.
- Stiegler, B. (2010). *For a New Critique of Political Economy*. Cambridge UK: Polity.
- Terranova, T. (2018) A Neomonadology of Social (Memory) Production. In I. Blom, T. Lundemo & E. Rossaak (Eds.), *Memory in Motion* (pp. 287-306). Amsterdam: University of Amsterdam Press.
- Tirocchi, S. and Taddeo, G. (2019). Come le pratiche digitali degli adolescenti possono cambiare la scuola. Il progetto "Transmedia Literacy.". *Scuola democratica*, 3, 551-574.
- Tota, A. (2018). "Educare alla libertà"? Uno studio etnografico in una scuola steineriana del Nord Italia. In R. Serpieri & A. Tota (Eds.), *Quali culture per altre educazioni possibili?* (pp. 143-165). Milano: Franco Angeli.
- Turkle, S. (1995). *Life on the Screen. Identity in the Age of the Internet*. New York: Simon and Schuster.
- van Dijck, J., & Poell, T. (2018). Social Media Platforms and Education. In J. Burgess, A. Marwick & T. Poell (Eds.), *The SAGE Handbook of Social Media* (pp. 579-591). London: SAGE.
- van Dijck, J., Poell, T., & de Waal, M. (2019). *Platform Society. Valori pubblici e società connessa* (G. Boccia Artieri & A. Marinelli, Trans.). Milano: Angelo Guerini e Associati. (Original work published 2018).
- Whitehead, A.N. (1947). *The Aims of Education and Other Essays*. London: Williams and Norgate.
- Williamson, B. (2018). The Hidden Architecture of Higher Education: Building a Big Data Infrastructure for the 'Smarter University'. *International Journal of Educational Technology in Higher Education*, 15 (12). Retrieved from <https://link.springer.com/article/10.1186/s41239-018-0094-1>
- Williamson, B. (2014a). Governing by Code: Software in the Governance of Education. *ESRC Code Acts in Education seminar*, 28 January 2014, University of Stirling. Retrieved from <http://codeactsineducation.wordpress.com/papers-presentations-writing/>
- Williamson, B. (2014b). Governing Software: Networks, Databases and Algorithmic Power in the Digital Governance of Public Education. *Learning, Media and Technology*, 40 (1), 83-105. Retrieved from https://www.researchgate.net/publication/269418435_Governing_software_networks_databases_and_algorithmic_power_in_the_digital_governance_of_public_education
- Williamson, B. (2013). Decoding Identity: Reprogramming Pedagogic Identities through Algorithmic Governance. Paper presented at British Educational Research Association conference, University of Sussex, Brighton, 3 September 2013. Retrieved from https://www.academia.edu/4477644/Decoding_identity_Reprogramming_pedagogic_identities_through_algorithmic_governance