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Open architecture curriculum: Towards an education committed to pluralist democracy

Rodrigo Travitzki
Universidade de São Paulo, Brazil: *r.travitzki@gmail.com*
Lilian L'Abbate Kelian
Universidade de São Paulo, Brazil: *lilianlkelian@gmail.com*

This paper aims to identify elements that will help with the process of thinking through curriculum issues based on the concept of open architecture. We argue that this concept can be an interesting driver of practice and debate concerning curriculum development in different contexts. More generally, we seek for viable public education that is more deeply committed to pluralist democracy; a pluralism with some consensus, but not on everything, as argued by Chantal Mouffe, in support of Paulo Freire's claim that no one frees anyone alone but in communion. The paper describes origin of open architecture in computing, highlighting the free software movement. Then, we briefly discuss the transposition of this concept to the educational field. We also describe some communities for practice and innovation. Teacher communities should be the main foundation of the open architecture curriculum. Teachers should be transformative intellectuals with the responsibility, among others, to listen to student voices. Finally, we describe examples of the open architecture curriculum, some real, some imaginary. The concept of open architecture can also help when conducting comparative studies to enable a better understanding of curricular differences between nations, particularly with regard to flexibilization and centralization policies.

Keywords: curriculum theory; education policy; pluralism; open architecture; collaborative community

INTRODUCTION

> No one frees anyone, no one frees himself: men liberate themselves in communion . . . No one educates anyone—no one educates himself—men educate one another, mediated by the world. (Freire, 1987)

What should people learn? What do new generations need to know before being fully active in society? How can we emancipate the people, or help them to emancipate themselves? Or maybe, more importantly, who is this "we"? Who is the entity that is trying to determine the answers to these questions on behalf of all others? Optimistically, we could be a group of teachers who are experts in several fields and from different communities but enjoying ideal conditions of communication, having a common interest and similar reasoning. We have the time and resources to create and update the national curriculum, and will not let personal interests distort the decision-making process. The premise implicit in the first three sentences is that it is possible to create a unique curriculum that makes sense for all people (e.g., in a country), and enables them to not

only to be included in society but to enjoy increased emancipation and self-realization. Using Habermas's (1992) terms, such a unique and universal curriculum is the outcome of a consensus generated in a healthy deliberative democracy.

Around the world, countries have different approaches to curriculum issues. Some countries have a more centralized and detailed approach, and others have a more flexible and generalist approach. Brazil is now completing a national curriculum that imitates the US *Common Core* curriculum and aims to guide the details of educational activities, such as textbook production, standard assessments, and everyday life in the classroom. The idea behind the curriculum design is that educators need more information about what to teach and how to teach, and also more "incentives" (or pressure) to do a good job. Additionally, as this information is more needed in poor communities, this standardization policy should be an effective way to deal with the reproduction problem, as described by, e.g., Bourdieu, & Passeron (1992)Coleman, "No child left behind," that's the idea, or at least a simplification of an explanation for this kind of public policy. However, its efficiency remains unclear, and some of its old defenders are now harsh critics (Ravitch, 2010).

> School Improvement, in neoliberal environments such as England, has intensified schooling rather than transforming education. It has led to speeding up the conveyor belt of transmission teaching, rather than a development of new social constructivist pedagogies. It is not surprising that fifteen years of such "improvement" has left a massive gap between the attainment of the poorest and most advantaged sections of the population. (Wrigley, 2005, p. 315)

In this paper, we argue that this common curriculum issue could be dealt with without the imposition of a universal reason related to standard assessments and mass teaching. We present no pragmatic solutions, just a conceptual tool that might help to deal with these—and other—curricular problems attuned to a perspective more related to education and culture and less driven by market interests. The tool we suggest is the "open architecture" way of structuring human actions and interactions, which leaves a large space for freedom and creativity without compromising compatibility and efficiency. The tool, or concept, is usually associated with buildings, hardware, and software. It has also been applied to education with regard to pedagogical methods, as Dewey and Kirkpatrick projects (Wrigley, 2005). More generally, our aim is to propose a way towards a kind of education more deeply related to pluralist democracy.

CURRICULUM, DEMOCRACY, AND PLURALITY

Curriculum issues are not mere technical educational details: they include political fields of struggle. In the Brazilian context, some details of this political dimension of the curricular issues are described by Miguel Arroyo (2014) and, in a broader sense, it has been addressed by Paulo Freire (1987). In a similar way, we assume that

> [A]s a starting point for assessing any discourse labelled as curriculum theory, the deeper political grammar that structures its view of power, sexuality and history, human nature and the future would be openly engaged and subject to critical analysis as a form of political discourse (Aronowitz & Giroux, 2003, p. 140).

Assuming that the curriculum is a form of political discourse—an important field of political (and ideological) dispute—we need to conceive of it in democratic

contemporary perspectives, which leads us to the debate concerning democracy between Jürgen Habermas (1992) and Chantal Mouffe (1996). Both authors were looking for a kind of democracy in which decision-making processes take into account human cultural diversity and avoid economic inequality. However, Mouffe (1996) refutes "Habermas's claim that there exists a necessary link between universalism, rationalism and modern democracy and that constitutional democracy represents a moment in the unfolding of reason, linked to the emergence of universalist forms of law and morality" (1996, p. 1). Her perspective, she claims, is aligned to Richard Rorty and Jacques Derrida, denying the "availability of an Archimedean point—such as Reason—that could guarantee the possibility of a mode of argumentation that would have transcended its particular conditions of enunciation" (1996, p. 1).

The centre of Mouffe's critique of Habermas's approach is the possibility of a consensus without exclusion. She claims that "when we accept that every consensus exists as a temporary result of a provisional hegemony, as a stabilization of power, and that it always entails some form of exclusion, we can begin to envisage democratic politics in a different way" (1996, p. 11). In order to undermine Habermas's concept of consensus, Mouffe (1999) refers to Wittgenstein, for whom "to have agreement in opinions there must first be agreement on the language used and this, as he points out, implies agreement in forms of life" (1999, p. 479).

If agreement is not established on significations but on forms of life, what should the democratic decision-making process be in a society with different forms of life? In Mouffe's (1999) perspective, "the novelty of democratic politics is not the overcoming of this us/them distinction" (1999, p. 755), because the existence of antagonist interests is constitutive of modern societies. There is always some discrimination between us and them, the point is how to establish it "in a way that is compatible with pluralist democracy" (1999, p. 755). In Mouffe's view, this could be reached in an agonistic pluralism, a concept that starts refusing the universal reason (or universal subject) one important foundation of Habermas's model of deliberative democracy.

> Modern democracy's specificity lies in the recognition and legitimation of conflict and the refusal to suppress it by imposing an authoritarian order. Breaking with the symbolic representation of society as an organic body—which is characteristic of the holistic mode of social organisation—a democratic society makes room for the expression of conflicting interests and values (Mouffe, 1999, p. 756).

Mouffe's idea of a pluralist democracy "demands a certain amount of consensus, but such a consensus concerns only some ethico-political principles" (1999, p. 756). And, even in these cases, she claims, the different and conflicting interpretations of the same principles could generate no more than a "conflictual consensus."

Stanley Aronowitz and Henry Giroux (2003) have a similar perspective with regard to curriculum issues that are more philosophically aligned with Dewey (2004) and Freire (1987). They are also worried about pluralist democracy but refute Habermas's faith in "a rationality which believes in the possibility of separating science from ideology to be another form of ideology" (p. 38). According to Aronowitz and Giroux (2003):

> Far from being treated as "objective" and as something simply to be mastered, knowledge claims that emerge within the curriculum would be analysed as part of a wider struggle over different orders of representation, conflicting forms of cultural experience, and diverse visions of the future. Underlying this view of curriculum

> theory lies the important task of helping students rethink both the democratic possibilities within schools and the wider society of which they are a part (p. 141)

Giroux and Mclaren (1986) claim that this view of education is in retreat since the introduction of neoliberal policies in 1980. They claim that nowadays there is

> Little concern with how public education could better serve the interests of diverse groups of students by enabling them to understand and gain some control over the socio-political forces that influence their destinies. Rather, via this new discourse, and its preoccupation with accountability schemes, testing, accreditation, and credentializing, educational reform has become synonymous with turning schools into "company stores." It now defines school life primarily by measuring its utility against its contribution to economic growth and cultural uniformity. (p. 218)

In this perspective, the curriculum is not influenced by teachers anymore but is mainly in the hands of administrative experts. In more extreme cases, Giroux and Mclaren claim, the curriculum is pre-packaged and designed to be "teacher-proof," to be applied in any classroom regardless the sociocultural context. Giroux and Mclaren perspective, which seems to be aligned with Mouffe's one, is not driven by cultural uniformity. Giroux and Aronowitz define a number of theoretical categories that could help to rethink curriculum discourse and practice: "1) an expanded notion of the political, (2) an attempt to link the languages of critique and possibility, (3) a discourse which views teachers as intellectuals, (4) and a reformulation of the relationship between theory and practice" (p. 140)

With regard to our goals in this paper, Giroux and Mclaren provide important concepts. First, the teacher must be considered as a "transformative intellectual" because "schooling represents both a struggle for meaning and a struggle over power relations" (Giroux & Mclaren, 1986, p. 215). It means that teaching and learning must be inserted in the political sphere. But this is not the same as viewing teachers as political activists or indoctrinators. Giroux and Mclaren (1986) argue that teachers must learn to listen to students' voice:

> Teachers must assume a pedagogical responsibility for attempting to understand the relationships and forces that influence their students outside of the immediate context of the classroom. This responsibility requires teachers to develop their curricula and pedagogical practices around those community traditions, histories, and forms of knowledge that are often ignored within the dominant school culture. This can, of course, lead to a deeper understanding on the part of both teachers and students of how both "local" and "official" knowledges get produced, sustained, and legitimated. (p. 236)

In a psychological perspective, this deeper understanding is related to the notion of active desire, described by Juliana Merçon (2013) in Spinozan terms.[1] Such a perspective is not the focus of this paper, it is detailed in Kelian & Travitzki (in press). The central point is how to conceive democratic participation in the educational field. Conceiving teachers as intellectuals with political roles does not mean corrupting education but taking it seriously in contemporary democratic contexts. Similarly, listening to students voices does not mean doing only what children want to do. It is

[1] "The activity [of desire] consists in the understanding of how we are determined by things, that is, in knowing the series of causes of our appetite and affections. Whereas reason is never only a cognitive process, but always also affective, in its activity it transforms our desire." (Merçon, 2013, p. 39)

important to go beyond strategies that simply ask the student at the beginning of the year: "What do you want to study?" and then doing, for example, a course in robotics because the student answered that he likes technology. We seek a more complex and enduring form of openness, a state of permanent listening that mobilizes many forms of subjects' expressions (their life history, their family culture, their political vision, their corporal organization, their language through drawing, oral narratives/written/technological, etc.). Such reflections are central to the debate about curriculum flexibilization as a solution to the lack of interest of young people in school activities.

WHAT IS OPEN ARCHITECTURE?

This term is usually associated with computing, either software or hardware, and collaborative projects. Open architecture is present in our lives in a variety of ways, such as in the personal computer and most Internet servers (based on Apache). According to Paul Wright, (1995), "open-architecture manufacturing systems may be defined as exhibiting: (a) connectivity between subsystems, (b) availability to a broad set of users, (c) expandability of both hardware and software, and (d) portability of software from one subsystem to another" (p. 200). Wright was talking about how to build computers but also pointing out a number of general principles of open architecture. The challenge is how to create flexible factory systems which easily convert ideas to precise mechanisms with quality assurance during the process. The success seems to depend on the "manufacturing languages, common data structures, compatible operating systems, and common bus structures for machine tools and other processing agents in the factory" (Wright, 1995, p. 187).

Taking a similar perspective, we consider the term "architecture" in the sense of a "habitable structure." "Structure" because there are common principles and specific forms of relationships between the elements. "Habitable" because this kind of structure does not make sense by itself, it only exists because it accommodates, within itself, several subjects in activity and interaction. An architecture is "open" if it can not only be inhabited but also be transformed by its inhabitants though always maintaining some structure. It must be permeable to elements external to itself, it must allow and facilitate adaptations and changes, eventually in the very foundations of the architecture. Thus, an architecture that proclaims itself as habitable for everyone but does not allow its inhabitants to make adaptations/modifications will not be considered here as an open architecture.

Therefore, an open architecture is a way of organizing environments of human interaction (real, virtual, conceptual) that seek to maximize collaborative action and collective construction of solutions and knowledge without supposing a universal subject—that is, a homogeneous subjectivity, a single perspective about being a human being. To do so, an open architecture must be designed with some basic principles: transparency, intelligibility, availability, flexibility, ability to incorporate the new/different, and coexistence of general standards and heterogeneity. To allow a better understanding of the open architecture, we present concrete examples of this concept.

HARDWARE OPEN ARCHITECTURE

The first computers were large and did not even have software in the sense that we know today: their physical structure dictated how to process information. Over time, computers became "multitaskers," smaller, though still expensive and still impossible to use every day. It was in 1981 that an IBM project (IBM PC) decided to create a low-cost computer. To this end, the designers chose to use standardized components already available in the market and, therefore, subject to free competition with no royalties. The idea was to produce an effective structure with the available electronic components, leaving only one protected component that would be produced only by IBM. This was an essential component for the integration of others (the BIOS), so the idea was to make some profit. But the initiative did not yield as IBM expected because other companies were able to produce similar BIOS, making PCs completely independent of IBM. From then on, the architecture created came to be called 'IBM PC compatible' and virtually all industries (except Apple) started to use it to produce personal computers. As a result, most computers we use today are based on an open architecture. The success of the IBM PC in the market of personal computers, hitherto dominated by Apple, can be explained in two ways: 1) the effectiveness and stability of the architecture created; and 2) the fact that the architecture is open (in technical and legal ways).

SOFTWARE OPEN ARCHITECTURE

The software industry follows the general rule of charging for products and innovations, usually in the form of a (usually temporary) licence of use. In addition to the fees charged, there is a second aspect that can "close" a software item: the non-disclosure of source code. Source code is what the programmer writes so it makes sense to a human being. When the manufacturer does not want to be copied or even understood, he only discloses the machine-readable code (basically zeros and ones). So, the software may work pretty well, but no one knows how.

The closed architecture of the software market began to be opened with the GNU Manifesto, published by Richard Stallman in 1985. He and several collaborators were engaged in building an operating system similar to Unix but open. In fact, the term GNU means: 'Gnu is Not Unix'. There were even legal challenges at the time, (e.g., related to copyright). To address this problem, Stallman created a licence for GNU, which he dubbed "copyleft" or GPL. The GPL licence, used to date, is based on four principles, the freedoms to:

1. run the program for any purpose;
2. study the program and adapt it to your needs;
3. distribute copies of the program to help others; and
4. improve the program and distribute the improved copies to benefit the community.

The GNU system was almost ready but there were still issues related to its kernel, that is, the part of the software that communicates with the hardware. It was in 1991 that Linus Torvalds created Linux, which became the core of GNU. Nowadays, the GNU/Linux operating system (popularly known as Linux) is widely used in Internet servers and scientific laboratory computers, although it is still rare among "ordinary" users. It is, in any case, the most used free operating system, with a community growth each year promoting improvement, stability, and diversity.

There are several "Linux distributions" available to anyone today on the Internet. Some are for general use others are specialized in multimedia, others are adapted for less powerful computers or for more security, etc. There is also considerable compatibility among the distributions because they are all based on the same open architecture: the GNU/Linux operating system.

The Linux community is mostly made up of users who benefit from the software created and made free by the small group of creators (the programmers) and also function as a software secondary testing system. So, there is a gain-gain relationship here. Any user can choose any distributor (or more than one) and any software available on the distribution repository. With no or few programming skills, a person can customize. With a little more knowledge a person can make their creations free to everyone. There are several structures on the Web that allows this kind of collective work, with different distributions, different programs, several versions of each one, several people contributing, and all working amicably. Of course, there are many problems and "bugs," as with any software, but the point here is that we already have the technological basis to manage complex and collective projects with transparency, flexibility, and efficiency, and integrating global and local features.

If we can do it with software, why could we not do it with a national curriculum? It is not a simple task, of course. However, more inspiration can be found in other free software communities: for example, the users of R statistic language. There are, of course few people in that society but, among statistics researchers, they are probably less rare than the Linux users among all people. The R software is a multi-platform, that is, it functions on Linux, Windows, and Apple systems. As with Linux, R is free to use, customize, and distribute, even with commercial finality. More than that, to use R you need to know something about statistics and the interaction with R can itself be a great form of learning both programming and statistics. This is because the R language has great affordance, it is written in clear English and all functions are provided with a standardized help menu, which is very useful for both beginners and experts. All these aspects are related to the open architecture and maybe they can help us to reframe curriculum issues.

LEARNING AND INNOVATING IN COMMUNITIES

The success of open architecture depends on the community acting and interacting in it, (re)building it while living in it. If we are talking about teachers in curriculum communities, there are at least two main features we should expect in these communities: the abilities to promote learning; and creativity at individual and collective levels. Teacher learning communities could be based on:

> What Dewey (1970) imagined years ago—a laboratory model for schools where teachers engage in collective inquiry in order to weigh their practices and innovations against empirical evidence and critical dialogue. Built on his broad conception of science and empirical data, Dewey's approach included systematic observations and analyses, conducted by teachers, of learning and teaching in classrooms. The process, he argued, ought to include focused professional conversations among colleagues, which in turn stimulate innovation and further inquiry. This spiralling process would culminate in ongoing construction of knowledge from practice (Wood, 2007, p. 282).

The main goal here is to improve teaching practice at the individual and collective levels. Open architecture thinking can help to provide an environment where each teacher can easily find, customize, and eventually create what is needed (an educational resource, a pedagogic method, an educational law). The environment must also allow teachers to debate, for example, how to use a specific educational resource, how to teach a specific content or skill, or even how to interpret a law. Like an Internet forum, but somewhat more structured by the ontologies (a kind of hyper-dictionary), which can incorporate specific educational features in a general and flexible form. Moreover, if the idea is to improve teaching and not to sell textbooks, this environment must accumulate knowledge in a transparent way, avoiding fake changes or duplications, and without losing information. In that way, it will not be necessary for a teacher to do the same work twice or more. At the collective level, this means a qualitative change.

Such an environment should provide efficient, democratic, and low-cost support to continuous teacher formation and refreshing. Moreover, it can help not only the users but also the creators of educational resources. In open architecture, creators must have a place and a good place. In this sense, it must be possible not only to customize the resources, but also to create totally new ones. Actually, if the idea is to build a kind of free curriculum (like the free software), the creators are the mainstay of the open architecture system.

Nevertheless, one could ask about the quality of the educational resources produced in such an environment. Could this kind of "autonomous creation" produce good resources without any company or some kind of centralization?

> Imagine product development without manufacturers. Today's user innovation communities are making that idea increasingly real. Open source software projects, among others, have led to innovation, development and consumption communities run completely by and for users. Such communities have a great advantage over the manufacturer-centered development systems that have been the mainstay of commerce for hundreds of years. Each using entity, whether an individual or a corporation, is able to create exactly what it wants without requiring a manufacturer to act as its agent (Von Hippel, 2001, p. 82).

Von Hippel (2001) describes two examples of successful products made by user innovation communities: the high-performance Windsurf equipment and the Apache software (part of most Internet servers). He highlights some similarities between the two cases:

- communities with many people participating voluntarily around common interests;
- spaces of exchanges and interactions are necessary: in the first case they are physical spaces, for which the athletes travel to practice and exchange experiences, in the second case it is the Internet; and
- the majority of participants in the communities are not really innovative, limiting themselves to use the solutions created by a minority that decides to make their innovations public and free.

Von Hippel is trying to understand this kind of collective creation in an economic view. So, one of the first questions is why (or under what conditions) does somebody decide to reveal and free his own creations, made with effort and investments. From an economic perspective, it means "when their benefits outweigh their costs. In the case of

user innovation communities, the costs of revealing are generally low" (Von Hippel, 2001, p. 85). When the costs are low (e.g., in the case of software), any tiny potential benefit would be enough to stimulate users to reveal their creations.

> [W]hat is most exciting is that innovation communities composed of users and for users, communities that according to traditional economic views shouldn't exist, work well enough to create and sustain complex innovations without any manufacturer involvement. This means that in at least some, and probably in many, fields users can build, consume and support innovations on their own (Von Hippel, 2001, p. 86).

Could the curriculum, in its broader sense, be one of these fields? It seems possible, taking into account that a large part of what we call curriculum can be converted to virtual objects (hence with very low costs of reproduction, modification, and distribution), and that teaching is a very specialized activity, which should work better—in the classroom everyday life—with customizable tools than with standardized mass methods.

OPEN ARCHITECTURE CURRICULUM

How can these examples help us to think about curriculum in the contemporary world? In transposing the concept of open architecture into the curriculum problem, we hope to contribute to resolving some issues in formal education, such as: the need to articulate unity and diversity in the curriculum; the distance between school and the state-of-the-art in pedagogic theory; the isolation of innovative schools; the isolation between schools; the isolation between disciplines; the lack of stimulus to innovation in loco; the lack of structured communities that can foster a culture of exchange and improvement of teaching work; and the need for constant teacher refreshing.

Actually, open architecture does not solve any of these issues. It is just a generic concept that still needs to be defined in educational terms. Even so, it can be an interesting driver to imagine curriculum solutions. The kind of solution that arises around this concept may contribute to many aspects of education, shifting the focus from "improve individual performances" to the collective construction of knowledge about education and about ourselves.

We consider an open architecture as a structure that can be inhabited by all interested people and also modified by such people. In philosophical terms, this is a perspective aligned with Mouffe and, when applied to education and curriculum, with the ideas of Freire and Giroux. The concept of open architecture contains a number of key features:

- transparency as accessibility (which includes cost and distribution) and intelligibility;
- standards of information, that allows communication, internal memory and compatibility;
- openness as the ability to incorporate the new, so the inhabitants can modify the structure;
- coexistence of heterogeneity and unity;
- easy to deal with and friendly, in order to promote large participation; and

- affordance, as an open way to incorporate intelligence on objects,[2] because one can easily learn how to use them.

There are several ways of defining these features and other forms of relating them to curriculum design. Some possible (and potentially inspiring) relationships between the concept of open architecture and the curriculum are:

1. curricular language understandable by the students (if possible, multilevel language);
2. educational activities with explicit objectives;
3. teachers are the users and main creators of the curriculum, they have formation communities to maintain and improve professional quality, and they listen to students' voices to promote meaningful education at personal and collective levels;
4. educational objects with free licence and permanent link, also related to some ontology[3] from the architecture. This can avoid unnecessary work for experienced teachers, and also allows long-term knowledge accumulation in the field;
5. ontology structure should be centred on the educational objectives, because we assume that the curriculum is a kind of political (and intentional) discourse;
6. ontologies are in permanent construction, elaborated preferably with more than one description for each concept, varying the language (hence the content) complexity; and
7. public school systems should be a general open structure that also allows local "closed" architectures if teachers want to create solutions but not publicize or systematize them (yet, maybe).

These are some promising examples, in our view. And there are three more cases (more complex relationships between open architecture and curriculum design) which are worth mentioning in this preliminary essay. The first case can be labelled as open pedagogies, from Dewey to Freire. They refer mostly to everyday classroom life, although related to causes and consequences from outside the school. The second case is known as Open Educational Resources. And the third case is what we consider a plausible (although still generic and not well defined) alternative for the "common core" large-scale curriculum solution with regard to public school national (or state) systems. These cases are described in the following sections.

Open pedagogies

There is a long tradition—since Dewey and perhaps Rousseau—in the debate and practice of more democratic and flexible forms of teaching. For didactic purposes, Janet Soler and Linda Miller (2003) identified three typical examples of curriculum, differing in the position in a continuum[4] defined by two extremes: one refers to more centralization, homogeneity and prior defined details, while the other extreme is the opposite.

[2] In a sense described, for example, by Dennett (1996).
[3] In this paper we refer to "ontology" in the context of the semantic web (as a digital dictionary), not in the philosophical sense.
[4] "A continuum ranging from localised, individualised models through to centralised goal-oriented frameworks" (Soler & Miller, 2003).

> The Foundation Stage Curriculum in England is an example of a centralised, competency-oriented curriculum, as it establishes and specifies national educational goals and content in advance. An alternative viewpoint argues for more localised and individualised models, generated to meet local needs in order to support collaborative community visions for young children. The Reggio Emilia emergent curriculum offers this alternative view, as it regards a centralised, prescriptive approach as stunting the potential of children by formulating their learning in advance. Reggio Emilia educators advocate an approach in which adults outline flexible, general educational objectives, but do not formulate prespecified goals (Soler & Miller, 2003, p. 66).

And somewhere between these two extremes should be an intermediate approach to curriculum design: Te Whäriki is a kind of "framework consultative approach to curricula" that "provides the main values, orientations and goals for the curriculum but does not define how these goals should be achieved. Interpretation and implementation is left to local decisions" (Soler & Miller, 2003, p. 66). So, the typical example of an open pedagogy is the Reggio Emilia emergent curriculum. Another important example could be the Paulo Freire's method of adult literacy. It is not only based on words used by the adult students—something not new, although rare at his time—but also based on a broader notion of literacy. Teaching must allow people to read the world around them, to know themselves and their position in the society; what should be more transformative in the context of excluded and oppressed people (Freire, 1987).

Another group of examples were identified by Terry Wrigley (2005) in an inspiring article which is the first mention of open architecture that we found in the educational literature. Wrigley refers to pedagogical methods that would better engage students based on: the interrelationship between experience and symbolic representations; engagement in activity in a learning community—a "community of practice"; a sense of empowerment by restoring voice and agency; and simulations are better than discussions or debates for various reasons (Wrigley, 2005, p. 311). Wrigley argues that this kind of pedagogy involves "a shift of focus from the single lesson to larger units of time," creation of spaces for voices and agency and even real audience or outcomes. Some examples should be helpful to make this idea clearer. Wrigley calls this kind of pedagogy "open architectures for learning," which give scope for independence in a learning community:

> 1) Project Method, as developed by Kirkpatrick and Dewey... begins with a theme or issue introduced by teacher or pupils... The next stage is independent research or inquiry, with each group or individual choosing to investigate a particular aspect. In the final plenary stage, each group presents to the class and stimulates further debate. Where possible, there is a fifth stage, involving a real-world outcome . . .
>
> 2) Problem-Based Learning... It begins with a situation, description or scenario which is difficult to "diagnose". The next step is for students to begin to articulate the possible problems. It then continues as Project Method . . .
>
> 3) Storyline is a form of thematic work structured by a narrative. This can be based on a novel, but more often the bare outline of a story forms the skeleton . . . It typically begins with a situation... The learners invent characters for themselves . . . The teacher . . . moves the story forward by announcing an event (Wrigley, 2005, p. 313).

Open Educational Resources

There are several free software applications and repositories based on open architecture premises which could be useful to manage curriculum resources in a flexible and reliable way. The Open Educational Resources (OER) are probably the first step, already in train in the open architecture curriculum movement. Some OER allow users to create their own content using digital platforms of collaborative work. One possible step ahead could be the legitimization of one or more OER as official resources for teachers of some city, state or country. In this case, special care must be taken on quality assurance, since everyone can contribute.

But even when the OER content is excellent, its categorization and integration rarely goes beyond some keywords. It is useful but could be more so. In order to improve the possibilities and efficiency of this categorization and integration of curriculum resources, certain digital technologies are promising. The ontologies, for example, are structured dictionaries with standard language and permanent links. This kind of dictionary not only describes the meaning of the words but also articulates words with other words and digital resources. They can work based on a simple triple pattern[5] that creates a structured data. This should be very useful in an open architecture curriculum. For example, one unique OER could be accessed with different perspectives, each one from a "real world" standard. So, the same educational resources bank could be accessed by someone interested in global principles, another person looking for national curriculum, or even a group of teachers trying to integrate their courses with their own ontology.

In this sense, we can build pluralist architectures that allow multiple views and uses of the same resource, each one with its own dynamics of interaction and knowledge accumulation. We already have open technologies to do this. We can build ontologies associated to structured semantic data, integrated to a collaborative OER and a course management system. All these "modules" already exist in free software. Each ontology would be a perspective, a way to interpret the educational resources and to integrate them. This should make the use of the OER more efficient, flexible, and easy for teachers. After all, the main intention is to improve the teaching-learning process. Given time, collective dynamics can emerge, creating a democratic environment of continuous professional improvement in education, which is our goal in this little exercise of imagination.

Public curriculum and free software

Before detailing the third example (the open architecture national curriculum), it is worth explaining more clearly the analogy between public curriculum and free software, mediated by the concept of open architecture. When transposing concepts, it is important to be careful and avoid misunderstandings potentially generated by the changing field. In this case, we are going from the informatics to the education, so a many things are different. For example, when a software is not functioning as expected, it is not difficult to detect the malfunction and its source, even if one does not have access to the source

[5] The triple is the basic unit of the data model called Resource Description Framework (RDF), consisting of 3 parts: subject/predicate/object. Or in general: first element/relation/second element. This basic structure is very powerful, flexible and robust, and could be a solid basis for an open architecture curriculum.

code. Since the software output is well defined, one can verify the functioning with a number of good indicators. In education, however, it is not so simple. How could we know whether there is a "bug" in the school or in a course? When can we be sure things are going according to plan? Do we have a plan? It is not enough (or even useful to teaching) to apply some large-scale standardized tests to check whether a school system is running well. Taking into account this and other limitations of the analogy between curriculum and free software, we can now focus on its potentialities. First, some interesting similarities:

a) most of curriculum and free software can be converted to digital objects, so they can be produced, modified and distributed at very low cost;
b) both need some explicit general standards, related to a group of concepts, an ontology;
c) both seem to work better (at least to the user) in customizable forms;
d) both can be understood in different levels of complexity;
e) assuming Giroux's view of teachers as transformative intellectuals, both curriculum and free software would be continually created by a community of users; and
f) assuming Mouffe's view of democracy in which pluralism means it is not always possible to have a consensus without exclusion, both public curriculum and free software would be based on conceptual structures that allows not only compatibility and unity, but also local singularities.

Furthermore, the local singularities are not seen as material imperfections of ideal concepts but are constitutive parts of the theoretical model of an open architecture curriculum. In this sense, local heterogeneity can be better understood as a source for legitimacy and creativity. The structure of free software could be a source of inspiration about how to work together in conceptual/virtual objects. It is a structure that enables a community to: produce collectively and individually; learn and improve collectively and individually; ensure transparency and ownership; make available publicly; and use, modify, or create products that are free, diversified, and compatible. This kind of practice and production, to be effective in society, must exist in several dimensions of human life: in the culture and the minds, in professional activities, in the law, in software platforms, formative courses, textbooks, and so on.

OPEN ARCHITECTURE NATIONAL CURRICULUM

What if countries like the US and Brazil try another approach to curriculum rather than defining in detail a "minimal universal content" that is supposed to guarantee educational rights/needs, and to be evaluated in standardized assessments? This approach might help in the management of the school system but is not much useful to teaching. A different approach is to design the national curriculum not for external psychometric accountability but to improve the teaching and learning process inside and outside the school.

A national (or state) open architecture curriculum should be a framework that allows heterogeneity of pedagogical methods, continuous local creativity, the emergence of general patterns while guaranteeing a level of comparability and management as well as being a useful tool for teaching planning. But its main goal should not be to facilitate management but to allow dynamic and self-organized processes to be managed to some

extent. It must be complex enough to contemplate the diversity of society but simple enough that it can be globally comprehended.

It is, therefore, intelligibility—and not management or assessment—the primary criterion for pursuing simplicity in the curriculum. After all, the recent development of informatics can help us to get rid of the constraints that rationalization has imposed on teacher work. Today, it is possible to rationalize human diversity without needing such hierarchy and homogenization, without replacing communicative reason with instrumental reason in (especially local) management. Computer science and free software have much to contribute in this direction but the challenge is much broader and goes beyond technology.

The communities of collective and transparent work—such as scientific or free software communities—should be the main foundation of the curriculum. Communities of teachers, with a creative minority, should be able to select or create didactic materials and develop plans according to open architecture standards. Perhaps these standards have already been created, perhaps they will be created by the community itself. There must be specific policies to consolidate these communities, guaranteeing virtual sharing environments and also periodic real meetings. These communities would be places of continuous formation of shared innovation and of cultural and technical enrichment. As a great part of curriculum is immaterial, it seems to be a fertile field to the open architecture professional communities.

What would be the overall structure of an open architecture curriculum? The central aspect should be the pedagogical objective, without which there is no intentionality and, therefore, there is no teaching-learning activity. The proposed objectives for each class, course or project are the pillar of the educational process, from which will be defined the strategies, didactic resources, and forms of evaluation. So, every element to be incorporated in the curricular architecture should have at least one explicit objective that, after being read, makes sense to teachers and students. This principle could connect all parts of the architecture in a transparent and useful way.

Such objectives would be associated with content, skills, etc., composing a kind of dynamic semantic network, with the purpose of facilitating and improving the teaching work. This semantic network could produce outputs in “traditional curriculum format,” useful to teachers, students, parents. Actually, depending on the complexity of the architecture, several different outputs could be generated from the same semantic network.

Several teachers from the same school could use open architecture to integrate their courses. A school could release the integrated set of courses in detail, including all necessary educational resources, as a Linux distribution in open source. It has great potential for overcoming educational inequalities and segregation. Different schools could generate curricula that can be used in other contexts, customized or not. Cooperation between teachers and schools should improve education as a common good, in these days when everything is an asset in the competition, generating closed and inefficient architectures. Some isolated creations could be integrated to the system in order to help and inspire others. The different curriculum conceptions and practices could be combined with common language, formats, and methods.

Schools that value student voice could provide greater visibility and recognition of their curricular practices, having to find ways to systematize their work in a way that is compatible with open architecture standards. Schools that give less value to student choices will be able to map content, skills, and materials more frequently in certain contexts (e.g., schools in a region) and use this information to define their curriculum.

An open architecture curriculum could allow a kind of flexibility that does not simply mean a menu (partly mandatory, partly optional) determined by "experts" to manage teacher and student activity. This other kind of flexibility is generated primarily by local creations, selections, and adaptations made by the users themselves (in this case, mostly the teachers). More than a "previously fixed flexibility," we seek for a kind of plurality as described by Mouffe. With more voice and agency, also inside a well-designed conceptual architecture, can teachers and students make the time in school most useful to learning. The goal is for diversity to be seen as a fundamental component of continuous innovation and collective construction of knowledge in education.

Like free software developers and users, teachers would organize themselves into production and learning communities, brought together by open infrastructures and common rules. Schools would publish details of their curriculum, such as open source Linux distributions. School systems would no longer express the desire of some to emancipate others (universally and obligatorily), but rather a meeting between different subjects seeking together the meaning of emancipation. Acting in the same structure, learning, producing, and accumulating together, keeping singularities and diversity.

But what could be the concrete form of this curriculum? A book? A digital platform with free access? An ontology created by a community of teachers and related to OER? Some institutions, supports and meetings to stimulate teacher communities? An ethical, legal and economic environment? An inventory of pedagogic methods related to specific objectives? A simple description of several ways to listen student voice? A group of indicators used to map different forms of learning, rather than comparing all in a unique scale? A large and simple vocabulary to facilitate communication and collective production in education? An emergent large scale curriculum whose core changes from time to time? A collective construction of some society, multidimensional and dynamic?

Maybe all of these.

THE IMPORTANCE OF TEACHER INTELLECTUAL ACTIVITY

Is it worthwhile investing efforts in this way of conceiving and practicing the educational activity? Are there many teachers willing to work in community? Would it not be more effective to centrally promote a curriculum reform than to tries to lay the foundations for a dynamic and complex curriculum that would be in constant reform?

Several studies—for example in Larry Cuban (1990)—demonstrate how curriculum reforms rarely have profound effects on the school system, either because of the resilience of the institutional norms or the professionals involved. In other words, what is planned on the "top" rarely affects the "bottom" as expected. On the other hand, several studies have shown that the quality of teachers depends on the career conditions associated with a certain autonomy, for example, see Martínez-Garrido and Murillo (2016), Fernández Batanero (2013) and Travitzki (2017). That is, a good teacher should be minimally creative and have a personal style of proceeding, as in other highly

specialized professions, such as medicine and law. Teachers cannot be just passive appliers of a general fixed curriculum. This important dimension of teaching is not easy to manage, but in an open architecture it can be recognized and improved. In fact, without a creative community, the open architecture has little use.

Educational activity is creative, despite all constraints. Many innovations are made every day by teachers, but most of them are made in closed architectures or "without architecture". For example, a closed architecture can be a state-of-the-art educational electronic platform with resources to study and assessment tools, but available only by payment, or only in an "instrumental perspective" (that is, with restricted view of goals and resources, without access to all information, in order to better achieve some goals externally defined). On the other hand, innovations "without architecture" can be those made daily by teachers who have the resources, time, and willingness to improve their work autonomously and critically, taking into account students' interests, the school project, legal frameworks, as well as their own talents. All these somewhat wasted creative potentials can be harnessed in an open architecture.

The closed architecture in the textbook is not restricted to price or copyright issues. There is an additional problem regarding the publishing market, which needs to create new products. Often, in new editions of textbooks, there are more changes in the form than in the content, when it should be just the opposite if the goal of a new edition is to make life easier for the teacher, including those who already work with it. For example, the number of some questions (usually at the end of each chapter) can change, forcing the teacher to check all questions he likes to use in each new edition. Sometimes, the question or some information in the text is taken away from the new editions although still relevant and up-to-date. These kinds of changes without real substance can create unnecessary hardship for teachers. It should not occur in an open architecture system such as free software.

The open architecture system can also help to develop scientific knowledge concerning education, structuring teachers experiences in collective frameworks (with common names and ontologies, at least). The goal here is not to seek a unified theory of pedagogy, but to help teachers with teaching while keeping their experiences in a dynamic memory that accumulates practical and theoretical knowledge. According to Anísio Teixeira (1977), it is important to:

> [P]rovide scientific conditions to the educational activity, in its three fundamental aspects—selection of material for the curriculum, methods of teaching and discipline, and organisation and administration of schools. In other words, it is a matter of bringing education into the field of the great scientific arts—such as engineering and medicine (p. 46).

Finally, the open architecture system can contribute to some significant issues relevant to contemporary education in democratic countries. Firstly, the distribution of students by ages. This school organization inspired by an "assembly line," with reproof mechanisms, becomes an obstacle to the progression of students, to the recognition of their potentialities and to their socialization. By projecting cultural homogeneity and creating an illusion that there is a standard of excellence to be achieved at every stage of school life, age-grouping favours practices of school discrimination, exclusion, and violence. A second issue in the contemporary education is whether—or to what extent, or when—students can make curricular choices and carry out their own projects. We

will discuss this later. And a third issue is the impact of socio-economic context on learning. Tolstoi (1988), Illich (1973), Freire (1987), Bourdieu and Passeron (1992) are among the numerous authors who investigated this impossibility of the system to distribute emancipation, starting with the assumption that certain knowledge—and specific ways of dealing with such knowledge—could be universally valid regardless of social group, class or culture. These are complex issues, there are several technical, cultural, and political components in each one, and clearly the open architecture system cannot do anything by itself. However, it can help if aligned with public policies and cultural movements.

FINAL CONSIDERATIONS

Public school systems are at the centre of the debate and struggle for democracy in contemporary terms. Standardized assessments have increasing influence in determining what should happen in the classroom. There is no place in a state or a national educational system, it seems, for a locally negotiated curriculum. Maybe, due to political and philosophical issues, maybe also due to a lack of technology and long-term viable initiatives. However, education is about influencing human beings, hence the principles that drives education (laws and curriculum) also defines what is a (good) human being. And it is not a consensus, nor a technical issue but a human, philosophical, and political problem—at least if one is aligned with a plural democracy. In this context, how can one recognize a unique "legitimate knowledge" if there is no universal subjectivity? Especially after discovering, since Bourdieu, that the criteria for legitimizing school knowledge contributes to educational and social inequalities between classes, genders, ethnicities. On the other hand, how can we manage groups of students and teachers doing different things?

The ideas we try to gather in this essay are well known in the educational field and maybe they just sound good sometimes, or contradictory. In fact, we present no detailed or concrete case for an open architecture curriculum. Our main goal in this paper is bring to light some concepts and experiences that can work as examples and inspiration of this simple idea: to rethink public school curriculum issues driven by the concept of open architecture.

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