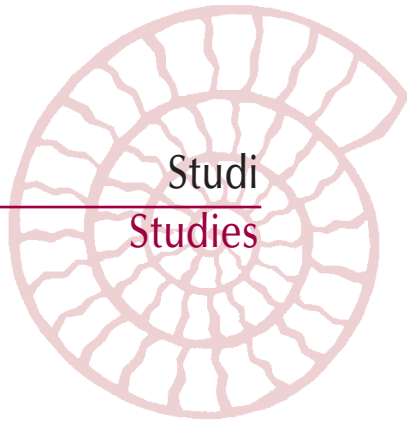

Studi
Studies

Developmental niche construction in education sciences: epistemological considerations and anthropological evidence on its outcomes for community education

Costruzione di nicchie di sviluppo nell'ambito delle scienze della formazione: considerazioni epistemologiche ed evidenze antropologiche delle sue ricadute nei progetti formativi di comunità

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ABSTRACT
This paper is divided into five parts. *Section 1* introduces *niche construction theory* (NCT) as a viable epistemic tool to cradle education within evolutionary and ecological accounts, inasmuch the latter ones are better suited to tackle the environmental issues recently identified by some key Italian pedagogists. *Section 2* outlines NCT and illustrates how *developmental niche construction* (DNC) – one of its derivative concepts – plays a pivotal role in the evolutionary account of education. *Section 3* identifies cognitive science as a further element to be taken into account: *prima facie*, cognitive research strategies seem to be at odds with an NCT-laden version of education of learning. Thus, this paper endeavours to show that, although a DNC-driven view of education calls for a broader rethinking of the explanatory role of low-level cognitive processes (*Section 3.1*), cognitive science remains a paramount player in educational practice – provided the *extended mind paradigm* is embraced (*Section 3.2*). Once proven DNC's liaison with cognitive science is ultimately non reductionist, *Section 4* explores two cases of how DNC-informed NCT influences teaching: firstly, by identifying educators (teachers) as niche-constructors (*Section 4.1*); secondly, by acknowledging the ability to construct niches is one of the most prominent educational goal learning communities can achieve in order to enhance their fitness. Finally, *Section 5* sums up the conclusions.

Questo articolo si divide in cinque parti. La *Sezione 1* introduce la *teoria della costruzione delle nicchie* (NCT), ponendola come valido strumento epistemico capace di includere la formazione nel contesto degli studi evoluzionisti ed ecologistici, in quanto questi ultimi dimostrano una maggiore capacità nell'affrontare le questioni ambientali recentemente identificate da alcuni pedagogisti italiani di riferimento. La *Sezione 2* dettaglia la NCT, e illustra come la *costruzione di nicchie di sviluppo* (DNC) – cioè uno dei suoi concetti derivati – giochi un ruolo chiave nella comprensione della formazione in chiave evoluzionista. La *Sezione 3* individua nelle scienze cognitive un ulteriore

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elemento degno di nota: *prima facie*, le loro strategie di ricerca sembrano essere ai ferri corti con una versione della formazione e dell'apprendimento informata dalla NCT. Pertanto, questo articolo si propone di mostrare che, sebbene una concezione della formazione guidata dalla DNC richieda un più ampio ripensamento del ruolo esplicativo dei processi cognitivi di basso livello (*Sezione 3.1*), le scienze cognitive restano un attore importante nel definire la pratica educativa – a patto che si aderisca al *paradigma della mente estesa* (*Sezione 3.2*). Una volta dimostrato che il legame della DNC con le scienze cognitive è tutt'altro che riduzionista, la *Sezione 4* esplora due casi di come una teoria di costruzione delle nicchie orientata dalla nozione di nicchie evolutive influenza la formazione: in primo luogo, identificando negli educatori (insegnanti) dei costruttori di nicchie (*Sezione 4.1*); in seconda battuta, riconoscendo che la capacità di costruire nicchie è uno degli obiettivi d'apprendimento più importanti che le comunità possono raggiungere allo scopo di migliorare le proprie opportunità di sopravvivenza (idoneità [*fitness*]). Infine, la *Sezione 5* sintetizza le conclusioni del presente studio.

KEYWORDS
Niche Construction Theory, Developmental Niche Construction, Epistemology of Education, Extended Mind, Community Education.
Teoria della Costruzione delle Nicchie, Costruzione delle Nicchie di Sviluppo, Epistemologia della Formazione, Progetti Formativi di Comunità.

1. Introduction

Agency is often understood as collective, shared with nonhuman species, and reliant on both biotic and abiotic processes (Lokman, 2017, p. 63; Morselli & Ellerani, 2020, pp. 90–93). This calls for a shift from anthropocentrism towards an ecological paradigm, with its renewed attention to the environment (Dozza, 2018). Attention to the latter is paramount in education sciences, and the '*Scienze della formazione*' research program in particular:[1] namely, it is acknowledged education faces the apparent paradox of having to cater to individual needs of self-realization while, at the same time, making learners heavily prosocial and able to tackle the ever-changing challenges of an increasingly integrated and globalized society (Minello, 2020). Consistently with such concerns, ecopedagogy advocates for the achievement of sustainability, broadly conceived – that is, not just in terms of ecological footprint but first and foremostly *qua* intersubjective harmony and well-being (Gadotti, 2010, pp. 204–208).

Consistently with such compelling scenario, this article sets out to find a suitable conceptual framework capable of re-joining ecological (and biological) studies with the field of education. In this respect, *niche construction theory* (NCT) appears to be the most fruitful approach. As the following sections will illustrate, NCT proves to be a fundamental tool to understand the way species co-evolve together with the environments they live in and contribute to shape. Moreover, when *developmental niche construction* (DNC) is considered, it can be shown

1 For a brief historical-epistemological assessment of said research program, see Marcelli (2020, pp. 151–153).

how exogenetic variation is generated by species, populations, and individuals – that is, adaptive phenomena that take place without natural selection, or in parallel with it.

Notwithstanding the above epistemic benefits, DNC raises challenges concerning the consistency between NCT and cognitive accounts of learning and education. However, said issues are overcome if cognition is understood in a non-reductionist way – namely, through the lenses of the *extended mind* paradigm (Clark & Chalmers, 1998).

But DNC does not stand out merely because of its epistemological value. In fact, its consequences for educational settings are tangible. In order to show this, two possibilities will be examined: that of regarding educators as prominent niche constructors, and that of regarding education as an attempt to increase the ability of a population to construct and manage its own niche. The latter case will be illustrated with reference to the anthropological results of the ethnographic fieldwork carried out in the Philippines by Li en, Lihtenvalner, and Podgornik (2012).

2. Niche construction theory

Education focuses on the emergence of novel behaviours, and *niches* might explain why novel behaviours may be born notwithstanding their lack of early alignment with the ultimate evolutionary functions of a species.

As reported by Prince-Buitenhuys and Bartelink (2020), Lewontin pioneered "niche construction" by suggesting environments are constructed by species (1983, p. 280), but it was Odling-Smee (1996) who introduced the idea of niche construction (NC) as one of the key elements linking cultural evolution and genetic evolution.

The concept of niche is revolutionary even without drawing on the case of human cultural development: it overcomes the idea that the environment is independent in its interaction with species, as well as the notion adaptations are just reactions to occurring environmental change (*ibid.*, pp. 195–196).

According to Odling-Smee, NC enables members of a species to effect changes in the environment, both *qua* short term effects and *qua* modifications that supersede their lifespans. Thus, they make the odds of future selective pressures dependent on their constructive action (*ibid.*, p. 197). This paves the way for a plurality of inheritance systems, some of which are partly exempt from genetic selection. Therefore, natural selection is always assumed to rely on at least two types of "sources:" the "independent" ones – which are beyond the control of the species – and the dependent ones, which result from NC on behalf of the target species or of "coevolving populations" (*ibid.*, p. 198).

2.1 From mainstream niche construction theory to developmental niche construction

For niche construction to thrive, there must be a targeted adaptation that results in a special behavioural trait possessed by the niche-enjoying species. That is, a population should be selected for NC. For example, Visalberghi and Fragaszy (2012) believe learning and education, in order to fall within the realm of human capabilities, must draw on the fact *Homo sapiens* has somehow acquired NC as one of her prevalent traits: namely, education and learning *require* it.

However, ever since Odling-Smee's early publications on NC, theorists have focused on the fact habitats do, in general, trigger the expression of genes – thus exerting selective pressures on a population (Stotz, 2017, pp. 1–2). But NC is different from habitat selection,[2]inasmuch it entails habitats are modified by species and, along with interventions of such magnitude, a feedback cycle is initiated between populations and their niches, so that both ends of the spectrum end up playing an active transformative role. Therefore, there seems to be sufficient consensus about the fact we should not view niches as the sole phenotypic results of specific genetic *loci*, but rather as the outcomes of evolutionary processes that are parallel to genetic inheritance (Odling-Smee, 1996, p. 197; Odling-Smee, Laland, & Feldman, 2003; Laland et al., 2015; Prince-Buitenhuys & Bartelink, 2020). Odling-Smee maintains:

> The capacity of any species to operate at [levels of construction with higher complexity] ultimately depends on its genetic endowement, and therefore on [evolution driven by population-level genetics] (Odling-Smee, 1996, p. 202–203).

In retrospective, such assumption supersedes Visalberghi and Fragaszy's concern for the identification of a unilateral NC trait (2012), although the intertwining between NC abilities and a species' own genotype remains a hot topic to explore. In this regard, Stotz (2017) examines a key distinction within niche construction theory (NCT):

- On the one hand, the resulting niche might exert selective pressures on a given population; in such scenario, variation is determined by which genes the niche selects for. When niches enact this way, Stotz speaks of *selective niche construction* (SNC).
- On the other hand, there are cases in which NC selects not only "for a new variation," but "also *produces* it" on the go. The process underlying such scenario is termed *developmental niche construction* (DNC).

Prince-Buitenhuys and Bartelink (2020) maintain DNC focuses less on "natural selection" and more on how "nature and nurture" affect "ontogeny". Consistently with such remark, Stotz agrees DNC matches the pioneering view of Piaget (1976), who had observed the "retroactive effect" of a living organism on the expressions of its genome. Moreover, DNC provides an account of "exogenetic (e.g. ecological and social) legacies," which are separate from population-level selective processes – this means adaptation can take place without natural selection (Stotz, 2017, p. 2). Such cases are akin to those summarized by Kendal, Tehrani, and Odling-Smee: Ihara and Feldman (2004) and Borenstein, Kendal, and Feldman (2006) studied on how education selects for different family sizes in each generation – also depending on the fertility preferences of the teachers. Given such patent interactions between social and biological traits, Lipatov, Brown, and Feldman (2011) propose to distinguish *cultural niches* – which constitute symbolical settings pivoting on the meaningfulness of language–and *social niches*, which determine social roles. Most unfortunately, Stotz does not mention such studies directly, exception made for Flynn, Laland, Kendal, and Kendal (2013). The latter popularized DNC by borrowing the notion from developmental psychology (Gauvain, 1995), but, in Stotz's

2 Concerning habitat selection, see Matsuzawa (2012, pp. 298–300).

opinion, should have avoided conflating DNC with those aspects of SNC of which it is "indirectly" part of (2017, p. 6). Eventually, a straightforward definition is proposed:

> DNC refers to niche construction where the constructed environment, as developed through interactions between individuals, other organisms, and abiotic processes, produces new adaptive, heritable, and phenotypic variation without invoking natural selection (Prince-Buitenhuys & Bartelink, 2020).[3]

2.2 Developmental niche construction explains education

Earlier, I have maintained education – and education sciences – should be concerned with NC because learning entails the emergence of novel behaviours. However, there is more to NCT than just an account of how variation might occur beyond the constraints of natural selection.

In fact, DNC is used by Visalberghi and Fragaszy to answer an evolutionary conundrum concerning what education does to learners. As it happens, learning emerges from a series of impractical and inconsequential actions, which constitute a repertoire of mistakes upon which the learner builds her competence. However, as far as evolutionary theory is concerned, this sounds highly inefficient: errors and low payoffs might diminish individual and group fitness, to the point of putting survival at stake (2012, p. 81).

Visalberghi and Fragaszy's solution is that of conceiving learning as a phenomenon that takes place in a sandboxed environment, where attempts at successful outcomes can be reinforced notwithstanding their initial poor rewards. Such "sandboxes"– or "niches"– serve the purpose of preventing learners from measuring up with those functions van Schaik, Burkart, Jaeggi, and Rudolf von Rohr call "ultimate," inasmuch they constitute matters of life and death for each member of a species or its progeny as a whole (2014, p. 66).

3. Compatibility between developmental niche construction theory and cognitive science

How does DNC relate with cognition? If DNC plays an explanatory role with regards to non-selective variation and offers a suitable environment for apprenticeships and trials-and-errors, does it follow a sufficiently developed niche could supersede the cognitive limitations of a species?

The answer seems positive for some aspects individual learning – which is ubiquitous, though it occurs in different degrees. Insects, for instance, are able to acquire and retain representations of new information (Dukas, 2008). Concerning nonhuman primates, they can 'learn' a number of words of sign language even though they do not seem to display the ability to exploit their syntactic potential and rely solely on associative mechanisms to understand the clues (Vonk & Aradhye, 2015, p. 483). Education, on the other hand, appears as a more complex human endeavour, which results in broader population-relevant niches: "humans are massive constructors of developmental environments" (Flynn et al., 2013).

3 See also Stotz (2017).

The complexity of education practices, broadly conceived, bounces us back to the earlier issue of a genetic endowment sustaining DNC on behalf of the human species. After all, the phenomenon is known to occur among some non-human primates in the wild (see, e.g., "master-apprenticeship" in Matsuzawa, 2012, pp. 293–295), and can be triggered at a more specific level in controlled environments (Iriki & Sakura, 2008). This means Hominidae enjoy some specific traits that are particularly favourable to DNC.

One answer could be that seemingly fixed elements (in behavioural, physiological, and genetic terms) might make functions negotiable when they are brought to work together. This mechanism is explained by the notion of integrated systems. Brownell and Kopp (2007) provide an account of them: integrated systems can be beneficial, for they supersede established developmental pathways, thus paving unprecedented new roads. In fact, whenever a regulatory system is present, sub-optimal individual traits increase their fitness: from 'sub-optimal, overall' to 'optimal *for*' (see, e.g. Cicchetti & Tucker, 1994).

If that were the case, it would mean DNC is a high-level phenomenon that is mostly explainable in terms of its low-level constituents. Yet reductionism is averted, inasmuch integrated systems are not what they are merely because of their components, but because of *how* their components *work together*.

But what if it is the niche that works as an integrated system? Think of communal coordination tasks, for example: they are taxing when subjects do not know each other and do not share much in common, but become increasingly easier when subjects are allowed to communicate; moreover, the surrounding environment might be arranged to the point that the task *comes natural*, without excessive energy expenditure on behalf of all participants – in a way consistent with the energy saving mechanisms described by Trenchard and Perc (2016, p. 41). At the first stages of this example, the burden of coordination still lies with the cognitive skills of each participant; however, by the end, it becomes clear the task could be achieved thanks to the enhanced setting, which acts as a proxy for the groups' cognitive skills.

This latter DNC scenario shares similarities with "the extended mind paradigm." Drawing on Arfini, Bertolotti, and Magnani (2019), it is possible to offer a summary of said paradigm: accordingly, the mind, by its own nature, is inclined to extend itself beyond the physical and physiological limits of the brain. Therefore, *to have* a mind always implies the ability to overcome one's own bodily constraints – at least, to some degree. For example, through computers, which act as the abiotic proxies of human cognitive functions, we enjoy the benefits of self-sustaining calculating processes which frees resources that might be directed towards other goals.[4]

Moreover, as demonstrated by Clark and Chalmers, we should not be afraid of ascribing cognitive processes also to scenarios in which individual processing is augmented through external means – even though most of the basics still belong to the brain (1998, pp. 8, 10). Such notion is loaded with consequences, for DNC theory does now respond to a cognitive checklist: whenever a purportedly supra-individual feature, when removed, affects the individual performance in a

4 Interestingly, as Gauvain (1995) observes, when proxies are employed to meet ends that are within one's reach, actual learning might be hindered; conversely, when instruments aid the development of cognitive skills (such as abacuses for counting), their usage is decreased with expertise, inasmuch experts possess the ability to perform with the aid of fictional (imagined) tools (p. 34). Of course, when goal-performances are beyond our reach, augmenting instruments are indispensable.

task (see p. 9), we ought to conclude that said individual's skill, competence, or ability, is distributed: after all, "cognition is often taken to be continuous with processes in the environment" (p. 10).

Thus, we might argue that, although DNCs can be of a general nature, NC reflects an inclination due to the mindedness of individuals (although they might not reflect their consciousness, which is a subset of it – see Clark & Chalmers, 1998, p. 10). Consequently, DNC-reliant learning – i.e. 'education' – could be understood as the result of a communal exercise of *mind-stretching*, in the non-trivial sense of the phrase. Generally speaking, most developmental niches are indeed cognitive niches.

3.1 A Satz 6.54-inspired scenario

A first consequence of the above mind-stretching scenario is sympathetic with Sterelny's notion of the "evolved apprentice" (2012) and bears more consequences for evolutionary psychology than for education sciences. I call it the *Satz 6.54*-inspired scenario. In his famous (or notorious) passage, Wittgenstein states:

> My propositions serve as elucidations in the following way: anyone who understands me eventually recognizes them as nonsensical, when he has used them – as steps – to climb up beyond them. (He must, so to speak, throw away the ladder after he has climbed up it.) He must transcend these propositions, and then he will see the world aright (2001, 6.54).

Here, Wittgenstein is trying to instruct us about how his work might enjoy indexical features with regards to unobservable objects, while, at the same time, acknowledging the ultimate emptiness of his linguistic 'gesture' (see Kenny, 2006, p. xi).

On my behalf, I draw on this passage not because of its ontological implications, but because of its inherent structure: Wittgenstein is describing a process that contributes to the achievement of a goal, which, at the end of the diachronic trail, proves redundant if not outrightly cumbersome. Something we ought to get rid of, especially if we want to enjoy the goal without anchorage to the history of our achievement.

A tentative argument could be put forward for the relation between low-level and high-level cognitive processes: we can liken the former to ladders that allow climbers to reach the upper ground, except that, once we got our way, said low-level cease to be functionally meaningful to us.

If that were the case, one could argue that low-level processes, when superseded by integrated ones, become less essential (and more negotiable) over time. Structurally speaking, think of the erection of an Roman arch bridge (Sinopoli, Basili, & Daniela, 2010): at first, a wooden support frame is built to help the placement of the main stones; then, once the whole construction is completed, the wooden frame is removed (p. 321). The non-negotiable has become negotiable (and even dispensable).

Does this mean that sufficiently complex developmental niches may act as minds without brains? My answer is, of course, tentative. However, if such idea sounds too far-fetched when it is predicated of purportedly stable human traits, it suffices to consider the latest developments in "artificial womb technology (AWT):" that is, a benchmark of how the necessity for fully functioning biological apparatuses is now being negotiated through technology (cfr. Romanis, 2018). If

anything, we might abstain from ascribing minds to developmental niches (or to the machines with which we populate them), and yet we would still be compelled to admit that, at the very least, they participate the *extension* of human minds (Pellegrino & Garasic, 2020).

If the that was the case, it would not mean we should dispense with cognitive science as a whole – e.g. by assuming that, no matter our neuroscientific insights, novel developmental niches will keep eluding our functional and evolutionary explanations. Quite the opposite: if *Satz 6.54*'s suggestion is to be taken seriously, it just means neuroscientific cornerstones are better integrated with DNC (and education sciences) when cradled within theoretical approaches that account for the supra-individual nature of the mind. On their own, they will still provide essential understanding of how the human (and non-human) cognitive architecture makes the environment relevant for the individual ontogeny.

3.2 Beyond the dyadic paradigm of bootstrapping

Drawing on Bruner, Jörg advocates a rethinking of educational practice as a bootstrapping phenomenon that involves at least two individuals, who end up developing together as a result (Bruner, 1996, p. 21; Jörg, 2009, p. 12). Although Bruner appears to favour the idea "sub-communities of mutual learners" can "be created", Jörg tries to make said concept more operational, and limits his contribution to dyadic interactions (2009, pp. 12–15).

Jörg's choice is motivated. His programmatic proposal for education sciences stems from a series of assumptions:

- What we call "education" has often failed to fulfil its generative role, inasmuch it has waived its power to enhance human potential and behavioural novelty in exchange for cookie-cutter conformism (p. 8).
- Although full-fledged antirealism cannot be embraced, we ought to abide by critical realism as the most viable approach in educational terms (p. 74). Accordingly, critical realism introduces us to the idea reality, as we live it, is the result of a constructive effort. Therefore, only by embracing a constructivist stance it is possible to make education effective.
- Cognitive science, when imported into the realm of education sciences, has given way to unpalatable results, such as the tendency of educational scientists to act "descriptive" (p. 6), to strive for "controllable" phenomena (pp. 4, 5), and, generally speaking, to display inability when dealing with the complexity of our reality-making essence (pp. 2-3).

In other words, by rejecting constructivism and by embracing cognitivism, education sciences are accused of having lost epistemic ground by letting the "blind spots" of the latter overcome the openness of the former (see, e.g., p. 5). Possibly, Jörg fears education sciences have run into a behaviourist pitfall – which, in fact, reflects strong realist ontological stances (Scheurman, 1998).

Contrary to Jörg, I maintain critical realism, much like the more radical antirealist stance, cannot achieve much without a robust theory of cognition to back it up. In his study on Bhaskar, Collier (1994) remarks emancipation by means of true convictions is desirable as long as it is "in-gear" with the occurring cognitive processes (pp. 192–193). Moreover, given the way cognitive science has evolved, education sciences have little to fear in terms of constraints: as NCT demonstrates,

cognitive science has long abandoned the idea of purely internal accounts of mental processes and has embraced the embodied dimension of the extended mind. Rescher's theses – to which Jörg is knowingly indebted – can still be upheld: "cognitive methodology" is not any more a detrimental strategy, but it is supportive of the idea we carry out a "domestication of the real" with our actions (Jörg, 2011, pp. 73, 243; see also Rescher, 1998).

If Jörg's manifesto is, after all, compatible with NCT, there should be no issues regarding the integration of his account of complexity with the above-outlined details of DNC and the extended mind. However, his model falls short of expectations.

As anticipated, Jörg's model is that of bootstrapping, which presumes a virtuous feedback cycle is triggered whenever two individuals engage in communicative interaction. Language is fundamental to Jörg's model, inasmuch, in his view, the 'making' of reality is achieved through sense-making. This is compelling: drawing on Kohler, we could agree meaning is essential when it comes to processes of education – *strictu sensu*: acculturation (2014, p. 194). For example, we might dig out a stone tool and wonder what it was meant for; after manipulating it, and reworking it according to its physical affordances, we might even be able to make it meaningful *to us*; however, we cannot call ourselves acculturated since its original purpose and value is lost – due to lack of communicative bridges between us and our ancestors.[5]

In other words, Jörg maintains learning is achieved whenever a new world-view (a new view of reality) is brought into effect as a shared interpretive good between communicating peers; moreover, the creation of novel world-views stresses the centrality of sense-making practices, in which peers make choices and, by doing so, develop narratives of their selves, as well as a sense of direction (2009, pp. 12–15).

And yet, there is an elephant in Jörg's room: the environment and, more specifically, niche construction. This does not mean that the educational transaction between communicating peers is badly conceived – quite the opposite, since it stands out because of its specificity. However, a dyadic intersubjective paradigm is clearly insufficient when it comes to highlighting the features of educational interactions – whose complexity Jörg aims to unveil. As already highlighted by Gauvain (1995), sociocultural influences cannot be accounted for in terms of dyadic models (pp. 39–41).

Moreover, by relying on a peer-to-peer paradigm that is driven by communicative feedbacks, Jörg fails to escape the reductionist atomistic models he intends to scrap (2011, pp. 18, 258). In fact, how could a multi-dimensional issue be tackled through a bi-dimensional framework? The result would be the same kind ontological poverty [*paupertas*] that Jörg (2009) identified as a flaw in previous accounts of education sciences (p. 3) – except that the atom, this time, is parted into two segments.

Thus, if the notion of sub-communities is essential and if bootstrapping enjoys ontological primacy in educational practices, then we ought to look at conceptual frameworks that overcome unary and binary models, for example by being able

5 This example is, of course, radical. By investing sufficient resources and by carrying out scientific inquiries, archaeologists can still *guess* the function and value of a given object—even in the absence of written records. But it is a hard task that is loaded with hermeneutic assumptions, and which does not reflect an active educational transaction taking place between scholars and the ancient crafters.

to account for several agentive forces of different (and, sometimes, incompatible) ontological status. This way, binary sub-communities would retain their educational value and role – as the centuries-old practice of mentoring demonstrates – but *qua* special cases of communities *in lieu* of being the *explanans* of a multi-level social reality.

4. On the field: teachers as niche-constructors vis-à-vis niche construction as a teachable skill

If NC – and, more specifically, DNC – is a key feature of education, we are prompted to ask what it means for those who, in our societies, are held most accountable for the outcomes of educational transactions: that is, educators.

I maintain educators are involved in at least two dimensions of NC: firstly, *qua* niche constructors; secondly, *qua* facilitators of a process of empowerment that transforms learners into niche constructors.

4.1 Teaching as niche construction

In order to prove my first point, I will draw on Park (2016)'s paper on the role of realism and antirealism in science education (pp. 75–76). As shown by Park, epistemic antirealism is an approach that can be rationally upheld. Antirealists have a parsimonious view of reality, since they commit to the idea that we cannot ascribe reality to what is not accessible through the senses – i.e. the "observables" (*ibid.*). Consequently, theories about "unobservables" are merely untrue. Such view seems to be coherent with the fact theories possess mostly an instrumental value, are usually subject to replacement, and point at reality not because of their own internal properties, but because they are supported by a network of other theories (*ibid.*).

Although it is tenable from a theoretical point of view, antirealism carries with it "pedagogical disadvantages," especially in the field of science education. Teaching science means most of the educational effort is dedicated "to help[ing] students form beliefs about unobservables" (p. 76). Contrary to Park, I maintain a certain degree of antirealism favours students' ability to generate new theories: by being critical, one is persuaded instrumental devices such as theories are useful but should not be relied upon forever – unless they undergo appropriate maintenance.

For the purpose of my thesis, the main point does not lie with the choice between realism and antirealism in science teaching. Rather, it lies with the fact Park incidentally demonstrates a point that shows how essential NCT is with regards to education: the efficacy of educational transactions depends on whether or not a sandboxed niche is created, in which learners can safely waive their ordinary antirealist convictions about what is real and what is not, and entrust the facilitator (or teacher) with helping them form beliefs about things that are not proximate (i.e. that are not *at hand*).

This means that possibly optimal science teaching should unfold in thresholds: at first, as advised by Park (2016), a realist niche is constructed, where concepts are taken at face value; later, the antirealist niche may be introduced, but provided the supporting frame of the epistemic bridge is robust. Advanced topics such as Heisenberg's uncertainty principle are accessible through the scaffolds provided

by earlier realist beliefs about unobservables: for example, Budzik and Kizowski recommend 'macroworld' analogies are introduced, so that pupils might develop a "better comprehension" of what the uncertainty principle is about (p. 665).

The notion of educators as niche constructors is also pivotal when it comes to special education. For example, Armstrong (2012) uses the concept of niche construction in order to illustrate how teachers should mind the setting when dealing with neurodiverse needs. Desutter offers a summary of his findings: to construct appropriate niches for neurodiverse learners, educators need to be aware of the learners' strength, express positive role models, make use of technologies, use appropriate learning strategies, mind human resources, embrace positive career aspirations, and modify the environment (Dezs , 2014, p. 65; Desutter, 2015, p. 28).

4.2 Teaching niche construction

It would be tempting to just claim that the teacher's main role is that of constructing a niche for her learners. However, as Desutter notices, the above educational tasks are usually difficult to master: as demonstrated by her interviews, special education teachers display full awareness of the need to create positive niches for their students, but frustration ensues when the latter effort proves to be exhausting and resource-draining (2015, pp. 28–29, 118–120).

Moreover, it should be appreciated niches – and developmental niches in particular – are rarely present 'one at a time' in individual ontogenies. Natural selection aside, as posited by Odling-Smee (1996), niches may belong to different ontological levels. While the existence of a niche might depend on the commitment of social agents, the existence of a niche of another type might be more durable, and even last beyond the life cycle of its active creators. For example, as illustrated by Arfini et al. (2019), cognitive niches are usually featured by persistent problem-solving devices that augment the performance of situated cognitive tasks – be they individual or communal (pp. 3-4).

Therefore, what was outlined above, in relation to Park (2016), might serve as a useful guideline to support basic didactics. However, given the fact niches are a ubiquitous constant in human evolution, one might wonder whether empowering education paradigms, aside from their localized function, have the goal of increasing the niche-construction capabilities of their target learners. In order to prove this point, I will draw on a study carried out by Li en et al. in the field of anthropology of education (2012).

Over the course of their ethnographic survey, Li en et al. were impressed by the communal aspects of education among the Aeta (variant: Ayta) people of the Philippines. Aeta's history is riddled with vicissitudes. They have experienced severe displacements in different waves: from the lowlands to the mountains, owing to Spanish colonization; from the mountains to the lowlands, owing to the eruption of Mount Pinatubo (*ibid*., p. 26). As a result, their environment was shaken both economically and culturally. In particular, at the time of the study, the Aeta faced inclusion challenges because of the writing-based culture that has taken over most of the Philippines – thus making literacy a primary concern.

Li en et al. highlight the inherently prosocial nature of the Aeta culture, where helping and sharing are widespread (pp. 29, 37). In addition to that, governmental, foreign, and non-governmental agencies intervened in order to introduce non-formal education practices among the populace. The course of action was agreed-upon by local leaders. The resulting 'system in the making' involved para-teachers

without official credentials, who are usually community members since they are the most suited to carry out training in a native-language medium; moreover, most educational programs are drafted in a bottom-up fashion, since they cater to the participants' needs (p. 31).

Such complex interactions between communities, leaders, organizations, locally appointed educators, and learners illustrate how educational niches come into existence mainly as the consequence of shared and coordinated actions. Such shared dimension puts individual goals in parenthesis, and casts doubts on attempts to transform "niche construction" into an operational burden for the teacher alone.

But there is more to this: in which way did non-formal education favour the inclusion of the Aeta in their new landscape of settlement? A brief answer could posit non-formal education provided the Aeta with skills – such as literacy – that are necessary to navigate nowadays' Philippines (*ibid*., p. 36). That is true, but Li en et al. stress on the following additional aspects:

- Educational leadership was given to local communities (p. 32);
- Educators were identified among community members (p. 33);
- Communities dictated their own educational needs, which contributed to shaping the curricula (2012, p. 32);
- Women participation was increased (p. 34);
- The local language – Tagalog – is used as a teaching medium (p. 32).

Consistently with these points, the Li en et al. see "community education" under the lenses of "active citizenship" (2012, pp. 26-27). Similar outcomes have been recorded, among the many, by Vakaoti (2012), Duveskog (2013), and Gani Dutt (2017).

But what is such activity if not an example of niche construction? Possibly, inclusiveness and a sense of belonging were fostered not because of some content conveyed during classes, but because communities were finally enabled to exert some sort of agency in the surrounding social and environmental context. In this regard, NCT represents a facet of the comprehensive view of educational settings foreshadowed by Margiotta (1997) and furtherly outlined by Morselli and Ellerani (2020): achievement in education is flagged by the construction of inclusive communities provided with generative power, which enables them to develop a level of agency, which, in turn, determines the existential success of their members (p. 98).

5. Conclusions

This interdisciplinary paper dealt with the understanding of education under the light of *developmental niche construction* (DNC) *theory* and attempted to show the adoption of DNC entails both epistemological and practical consequences for education sciences.

Niche construction theory (NCT) is now an established branch of evolutionary studies, which aims to explain exogenetic evolutionary processes. The latter are borne out of durable niches resulting from the creative interactions between species and the environment they live in.

The polysemic nature of the concept of *niche* allowed for the multiplication of derivative concepts, as anticipated by Odling-Smee (1996): cultural niches, in-

dividual niches, developmental niches, and population-level niches (p. 203). However, I have sided with Stotz (2017) in maintaining education finds its place in evolutionary frameworks if we abide by the notion developmental niches. By constructing developmental niches, species (and segments thereof) unlock unprecedented opportunities both at a generational and at an intergenerational level: in other words, developmental niches work as exogenetic sources of variation – to which we can ascribe the generative assets of populations.

However, by siding with the idea of DNC, it might be objected the cognitive dimension of learning and education is being overlooked. *Prima facie*, such outcome is consistent with Jörg (2009)'s theory, which advocates complexity at the expense of the purportedly reductionist investigations of cognitive science. Contrary to such view, I have firstly endeavoured to show Jörg is at a loss, since, if we abide by his view, reductionism sneaks back in together with a dyadic approach to communicative interactions and sociocultural influences – such as educational processes (Gauvain, 1995). Moreover, I have shown DNC is consistent with the latest non-reductionist cognitive accounts. In particular, I found the paradigm of the *extended mind* could be the most appropriate one to bridge the gap between cognitive science and ecology-oriented NCT.

Said liaison is laden with consequences for education sciences. Within the limited scope of this article, I elected to deal with two of them, concerning teaching. If DNC theory is to be upheld, niche construction becomes a viable account of what teaching is about – thus superseding all the different definitions of teaching entailed by the historically alternating theories of learning in vogue during the Twentieth century (Scheurman, 1998). Additionally, since by treating teaching as niche construction we imposed supererogatory demands on educators, I was prompted to inspect whether the communal nature of niche construction should be valued instead. The final answer – supported by anthropological research into the subject of community education (Li en et al., 2012) – is positive, and illustrates how supra-individual educational outcomes, such as inclusion, can be achieved only by transforming learners into niche constructors.

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