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A SHIFT IN SYSTEMS: (CO-)CONCEPTUALISING PEDAGOGY IN AN ERA OF CONTINUOUS COMPLEXITY

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ABSTRACT

As a result of complex co-constructive entanglements of contemporary lived-experience, this paper develops ideas from posthumanist and material perspectives on education, that recognise, unpack and analyse the particular dynamic, co-constructive nature of the postdigital entanglements of technology *with* the epistemic and ontological development of students (Bozalek, Braidotti, Shefer and Zembylas, 2018). Drawing from Haraway's idea of symbiogenesis, (2016), this paper suggests that a critical facet of contemporary pedagogy requires an understanding of the key skill of *poiesis*, to render visible the entangled ontology of the contemporary postdigital adolescent to better inform appropriate pedagogic developments.

1) INTRODUCTION

There are many transformative elements that inform successful pedagogic development which impact, improve and evolve our understanding of student learning experience over time. From behaviourist ideals of cause and effect (Skinner 1948, McLeod 2018) to constructivist and social-constructivist ideas (Piaget 1954, Vygotsky, 1978) and more recently to co-constructivist posthuman concepts (Bozalek, Braidotti, Shefer and Zembylas, 2018, Braidotti, 2019) that refer to the agency of both human and non-human elements in co-creating (learning) experiences and thinking. In education, these different movements reflect the changing attitudes and ideas that shape the way education is informed and delivered in our schools. This is particularly visible in previous didactic models of teaching that dominated education in a mechanistic environment during schooling in Britain during the 20th century (Efland, 1990). However, technological progress of the 21st century (most notably the public implementation of the 'internet' in 1993) has accelerated global connections and the availability of information to the public (of all ages) engineering a complex, hyperconnected, smart environment that has altered the way in which people interact, develop and learn (Ihde, 1990, Verbeek, 2011). Drawing from the idea of 'symbiogenesis' (Haraway 2016) as a way of

situating an understanding of our relationship to this rapid socio-technical evolution, this article considers how pedagogy might evolve to better facilitate adolescent learning at such a time.

2) POSTDIGITAL ADOLESCENT LIFEWORLDS: TANGLED BECOMINGS AND TEENAGE ANGST

Contemporary curricula urgently needs to reconsider the distribution of *epistemic responsibilities* (Simon in Floridi, 2015) if it is to develop an appropriate means to for children and adolescents to learn how to navigate contemporary environments which are increasingly unstable (Tønnessen 2018, 2009, Page 2009), unpredictable, hyperconnected and highly complex. Research has shown that young people do not perceive online and offline living, but rather a blended hybrid space where life-lived materialises between analogue and digital spaces (Beavis, 2013). As young people have become more recognised as 'consumers of goods and educational devices' in the twentieth century (McGregor, 2013, p. 3), attention on both the relationship they have with digital-media and the manipulation of their agency have sparked focus from a range of fields such as advertising, sociology, psychology and education (McGregor, 2013). The grouping of generations has also sought to impact mass-perceptions of how the youth appear to live their lives. For example, Gen Y (1980–2000) are often understood to be 'overly pampered, "tech savvy", narcissistic [and] ambitious', whereas Gen Z (2000 onwards) were the first generation born into 'a world of unprecedented communicative technology' (McGregor, 2013, p. 3). This rapid technological development has had a profound effect on the way teenagers appropriate objects, spaces and things in their lives, and schools have found it difficult to develop pedagogy in parallel to facilitate appropriate support with these technological changes (Beavis, 2013). This has led to escalation in disaffection and disengagement from students in many schools, in addition to an increase in anxiety and depression among teenagers which is now at an all-time high (Twenge, J., 2020). Previous education reforms have failed to fully understand this complex issue (Ofsted 2018 'knowledge rich curriculum', Donaldson 2015, Smith 2013) focusing instead on educational solutions to superficial questions, rather than focusing on deeper entanglements that co-construct the onto-epistemological issues that teenagers are facing. There is a distinct lack of skills-teaching in schools concerning the understanding and analysis of contemporary complexity and social phenomena, which has been highlighted further by the challenging shift to online delivery for many schools during the COVID19 pandemic and its impact on 'lost learning'. Education correspondent Hazell, (2021) quotes Ofsted boss Amanda Spielman who states;

> ".. the extent that children have catching up to do, most of that will happen in the normal classroom with the normal teacher… much of the recovery work over the next year, two years, three years will be about making sure that the children who have come adrift for whatever reason get the extra help they need to bring them back into the range of that normal teaching so that they get the full benefit from all aspects of school education".

Despite being part of technologically hyperconnected (Floridi 2015) global community (Bozalek, Braidotti, Shefer and Zembylas, 2018), where circles of influence extend to a global reach and the touch of button, it would appear that pedagogic methods and philosophies have not yet made the appropriate shift. It is evident that although there have been developments with online pedagogies (Sharples et al. 2015), these pedagogic principles have not fully considered the means by which young people use digital communication and have failed to account for the 'digital-divide' which was highlighted further during the COVID19 pandemic. An interesting element highlighted by Sharples et al. (2015) was the growing development of incidental learning, where learning is not lead by the teacher but rather occurs in an unpredicted manner via a digital device such as a smart phone. 'Embodied learning' is also discussed in the development of *innovative pedagogies* (Sharples et al., 2015). However, this discussion remains rather superficial in its reference to the dualisms of body/mind engagement in learning, and would benefit from further developments from the philosophies that dissolve this dualism (such as phenomenology), where knowledge-making processes are enacted and embodied in a holistic mode of synthesis, using engagement to *situate learning* rather than 'to support the learning process' (Sharples et al 2015, p5).

It is important to consider that although the youth are often seen as 'tech savvy', the 'digital divide' (Samuelsson & Olsson, 2014) has led to greater disparity between socio-economic comprehensions of what it means to be a participant in school. Despite growing up in a highly technological era, some students have limited access to some technological tools. However, these technologies are still dominant agencies in the contemporary environment, even if their influence is entangled in an intersectional perpetude (bell hooks, 2000) - what some people do not have access to, influences how they understand themselves and their co-constructed reality. This in turn perpetuates how we understand, recognise and label our social and cultural hierarchies and developments. A need for socially just pedagogies is not just vital during such technological globally-connected times, but a productive ally in developing awareness of our (co-constructed) paradigms and how they preserve thinking for future generations – an awareness of the stories that have been lost due to cultural perpetuity. Through technology and education,

our students have the opportunity to develop deeper comprehension of the multiplex of realities that entangle contemporary knowledge. Education is a tool by which we can begin to shed light on this rapid exposure of globally entangled ontologies that the youth interact with daily.

For contemporary curricula in a highly complex hyperconnected era, the basis of information and knowledge needs to be understood and (re)considered at both a macroscopic and microscopic level, as both feed into and dramatically impact the rapid fluctuating changes in socio-technical lived-experiences of individuals. These practices are intertwined and distributed, referred to as 'socio-technical epistemic practices…' (Simon, J. in Floridi, 2015, p 146) as they shape and develop thinking influenced by *multiple agencies* (human and non-human) including an array of productive infrastructures and technologies. It is important that we (re) consider the epistemic processes and responsibilities promoted by curricula and pedagogies (Bozalek, Braidotti, Shefer and Zembylas, 2018) as this needs to consider the productive entanglements of contemporary social phenomena and how they shape and develop thinking in students. This expanding notion of influence is reflected in our students who are at once community-minded open and accepting, whilst simultaneously coping with an evolutionary emergence of a new technoetic-becoming. Their lived-experience is lived across differing spaces and time-zones as they transact with physical and digital spaces on a microsecond basis, which means that their ontological development (when they respond or act in relation to any space) is rendered visible to both a local and global audience of differing demands, beliefs and values. This exchange leaves them vulnerable through interactions with complex, distributed power systems, which weave stands of influence (and manipulation) into this *bio-digital becoming.* This becoming is susceptible to alienation, abuse and reproach from multiple modalities, spaces and time-zones. It is imperative that we support students in better comprehending these discursive formations (shaped by subtle but powerful nuances from both human and non-human influences) and how they productively co-construct formation of mind, thinking and becoming. In studies on distributed power-relations (developed from Foucault's work on the relationship between power and knowledge) it can be understood that;

> '…power is vested in the practices of collectivities (discursive formations) that determine what counts as legitimate evidence and acceptable forms of arguments through so-called regimes of truth. How is rational discourse possible if invisible regimes of truth govern its agenda and procedures…?'
>
> (Mingers and Willcocks, 2004 p208 referring to studies by Foucault and Habermas)

Rather than reprimand students for their relationship with technological tools (mobile phone bans in schools for example), in favour of a means of comprehension that we are more familiar with based on previous understandings of what is 'appropriate' in terms of out-dated analogue-only interactions. Perhaps our role, as teachers and educators, is to help adolescents to negotiate a moment of transition into an accelerated lifeworld of which they are *becoming-with* (Haraway 2016). This lifeworld is always susceptible to the timely modifications and subtle semiotics that demark each era, but at any given instant highlight a given set of social, cultural, personal and ecological values. The transient ontology of adolescents is radically (re)forming due to rapid instabilities of contemporary socio-technical fluctuations (such as availability of information, social phenomena and global-culture) that co-construct this interesting and timely lifeworld in an information-saturated, globally-connected era. Pedagogy needs to develop more purposefully so that it can assist in a more holistic comprehension of the entanglements of such an era.

Mingers and Willcocks, (2004) argue that;'

> 'The lifeworld concept has some interesting implications for [Information Systems] research…because it is a prerequisite for introducing Habermas's concern that the success-oriented, teleological, societal macro systems of the economy (consisting of markets and money) and government (public systems of administrative power) could overpower ('colonize') the lifeworld… [Information Suystems] could become accessories to certain social tendencies that undermine the resources of the lifeworld, making agreement-oriented communicative action more difficult, thereby producing a consensus deficit in modern societies'
>
> (Mingers and Willcocks, 2004 p197)

With radical rises in anxiety and depression amongst adolescents and clear 'ontological crisis' due to constant change and rapid ontological shifts (Luke and Luke 2001, Tønnessen 2003, 2009), there needs to be alternative methods of abstraction deployed that can better render visible the fluctuating and emergent constructs that form the fragile distributed lifeworlds of contemporary adolescents, so that these issues may be addressed and better understood. The acceleration and evolving use of 'Phatic Technologies' (Wang, Tucker & Haines, 2012) highlight the need to better comprehend the influence this is having on how young people consume and have *agency* with these productive social technologies, and how it is changing their thinking, including conception of what social behaviour and interaction means to them. The separation of public and private life have

transformed and developed across hybrid spaces where separations have become blurred and boundaries confused. The use of technologies re-embeds us in a web of social (power) relations – a layering of communication and relationship-building, as well as distributed co-constructive practices of knowing, beliefs and semiotics. This is an entangled relationship that emerges between the producers, users and non-users of these technologies, which begins to shape the onto-epistemic developments of each individual as they enact their (co-constructed) ideas, values and behaviours in the world. Phatic technologies (Wang, Tucker & Haines, 2012), for example Facebook, TikTok, eBay, Amazon, have become deeply embedded in our daily lives and need to be considered in relation to contemporary pedagogic methods. Let us think for a moment about the tangled lives of adolescents that we teach. How do these young people's lifeworlds entangle amongst and with other lifeworlds? What constantly influences and co-constructs their sympoiesis and symbiogenesis (Haraway 2016)? How can this inform how we teach and develop thinking-with these timely entanglements to facilitate learning?

3) LIFEWORLDS: THE DYNAMIC, MULTIMODAL STRUCTURE OF OUR STUDENTS

Students are shaped by an uncountable number of human, biological, technological and environmental influences contingent on time of day, situation, health, wealth, mood. These elements or assemblages of experience shape and frame how experience is understood and lived by an individual, as all experience is individually *affect-framed* and *situated*, thus developing the progressive reality as it unfolds for each student. In turn, each individual does not remain isolated, but rather interacts or co-acts to influence others through conversations and interactions with other people, places and things (Ingold, 2000, Harraway 2016, Braidotti 2019). A clear shift in educational comprehension is needed to better understand this complex meshwork of teenage agency that shapes and co-forms the thinking and ontology of our students.

3.1) Martha Muchow: The world lived by the child/ adolescent

In order to understand this lived-world, it is useful to consider how a lifeworld model has been previously applied to young people. It is appropriate to understand that a lifeworld informed understanding of both older children and young adolescents is not new, as can be understood by the previous less-known work of the German child psychologist Martha Muchow (1892–1933). However, by looking at

how Muchow's study has informed an understanding of human-lifeworlds, particularly those on the boundary between child and adolescent, it can provide an insight into how this idea could be conceptualised in future case studies with adolescents.

In her phenomenological study, "The Life Space of the Urban Child (1935)", Muchow focused on the lived-worlds (realities) of children and young adolescents and considered how these young people (as actors) appropriate their city environment (Mey & Gunther 2015). The study was one of the first of its' kind and drew inspiration from the work of von Uexkull in relation his lifeworld theory (1909) (which will be discussed later in this article) but considered human lifeworlds as lived by 109 children and young adolescents (both sexes), aged 9–14 living in Hamburg during 1927–1932. Muchow wanted to focus on the conceptual matrix of the urban young person to better comprehend their actions in relation to their cognition of their environment.

She used an approach that considered (inter)relations (and interactions) between young person and environment. This is understood in relation to the relationships children and young adolescents have with others and how this determines their reactions and action responses. Her study investigated the emergence of the world (in relation to their developing lifeworld and the *tone(s)* this generates) not only as it is experienced by the child or young adolescent (subjectively) or in a purely physical and concrete relational manner (objectively), but also as the young person lives his world (from a developmental and cultural psychological perspective).

The study began with the intention to illustrate;

> '…how the city – as a particular world- is able to influence and shape the young people who live in it…[however]…the more the person-world relationship was rationalized in fundamental new manners, the more evident it became that, in the child-city relationship, it is not the world of the city that "only enters in contact with the person (child) through a subsequent convergence'…Rather, the world 'lived' by the urban child, as is the case with any 'lived world', is a particular life that takes place between person and world' Muchow and Muchow (in Mey & Gunther 2015 p. 63).

In the study, the participants were asked to mark on a map, the places they frequented such as residence, schools, swimming pools, youth clubs etc. and to colour all streets and places they know very well in blue and the streets and places they know less well in red. Muchow found great difficulty in truly understanding how the young people lived through their own lifeworlds, as she was very aware

that everything she analysed was understood through her own lifeworld. She was very conscious of this issue as the difficulty in this was not translating their geographical knowledge onto a picture of a map;

> 'but rather having the streets they know present in their mind at the moment of the research…to go through that space in their imagination, and then transfer that image to the map' Muchow and Muchow (in Mey & Gunther 2015 p68).

Muchow wanted to be as transparent as possible in understanding the realities of the young people as they see and understand it themselves and this '… 'lived world' could be very different depending on the structure of the person who live this world… [making it]…necessary to turn to the then-current studies of the 'person' and to investigating the 'personal world' Muchow and Muchow (in Mey & Gunther 2015 p65).

3.2) The conflicting life-worlds of young people and adults: Loading dock (Muchow Case study 1935)

Muchow analysed the differences between the driving factors and focus points of the action worlds in young people and how this was very different to the driving factors and focus points of adults (Mey & Gunther 2015). In her study, she considered different environments within the local area and how these were interpreted into the lifeworlds of both the young person and adult. Muchow understood that these locations appeared different as most adults did not acknowledge the active environments that the young people held as important places of various *action*.

An example drawn on from Muchow, is the Loading Dock. This area of action was frequented by 99/100 adults who focused only on the path ahead rather than the place itself and the objects it held. The adults did not actively engage with the loading dock beyond a *glance*, as they remained focused on their route through it, meaning that it did not appear to affect or evoke response from most of the passing adults. The parking lot had become part of the adult 'surroundings' but not their 'environment' (Mey & Gunther 2015 p 96). The adult focus remained fixed upon its pre-defined action and purpose – a place where other adults enacted their specific duties such as emptying bins and off-loading packages from the ships.

The loading dock '…although characterized initially as "made by adults for adults", is not very present for most of them, with only a few more or less integrating the site into their specific world. The site is only seldom used in a place-specific manner'

(Mey & Gunther 2015 p 97).

In contrast to this, in the world of the young person, the loading dock *became* something very different. Muchow highlights that, 'The loading dock means as much to the children as little as it means to adults' (Mey & Gunther 2015 p 97). The young people whom engage with the location were twenty times higher than that of the adults and they also behaved in very different ways. This highlights that the abstraction process can be much more *extreme* and visible in young people, who imagine objects and places to become completely different things that can facilitate and reflect the *tone* of their progressive lifeworlds. This highlights how the stability of this 'world' differs between adults and young people and how surroundings become part of the environment of a lifeworld. As a young person matures he/she learns the cultural codification of objects and spaces, in addition to the cultivation of their own individual and colloquial semiotic filter. This is particularly important if we consider adolescence, as the development at this biological period begins to have a stronger influence from peers and risk-taking behaviours increase. It is important to consider that

> '…we [are]… not dealing with the three-dimensional mathematical space that epistemologically is the basis for all possible knowledge. "Space" was conceptualized as a concrete space 'wherein' we exist, and especially 'wherein' …dwellers exist, that is…[their]… space' (Mey & Gunther 2015 140–141). The structure of the young person's lifeworld does not depend on the views or 'facts' of adults (Mey & Gunther 2015), but is highly informed by the influences of entanglements and their maturity at each age.

3.3) Analysing the lifeworld model: Abstraction through Jakob von Uexkull

Uexküll (1909) made it possible to 'reality as actively lived', through dynamic evolving perceptual 'lifeworlds' (Uexküll, O'Neill, Sagan, & Winthrop-Young 2010, Buchanan 2008). The lifeworld model went *beyond* representation and through a process of phenomenological abstraction, rendered visible individual and species perception of their own 'reality'. Uexküll's bio-philosophical model went further than Husserl to explore and engage with the symbiosis between environment and the subjective world of the species or individual, dissolving dualistic separations into holistic models of *dynamic* perception and action (Buchanan 2008). For Uexküll, the isolation of objects for study by science during the early twentieth century created an incomplete mode of understanding and he found flaws with the Darwinian concept of natural selection as a sufficient explanation

for our comprehension of species and their development (Uexküll, O'Neill, Sagan, & Winthrop-Young 2010). An important departure from the dominant objective, neutral and universal understandings of 'reality', towards a more distributed, ecological and progressive comprehension. In Uexküll's model, the reality of the individual being does not remain fixed, but rather continuously develops in relation to the 'inter-*actions*' and inter-*reactions* which co-form and re-form individual lived-reality.

3.4) Tone in the lifeworld: affect-framing and situating experience

For Uexküll, the lifeworld of an individual occupies a specific *tone* that develops (and continues to develop) differently for each individual being. When discussing *tone* Uexküll provides an example of how an oak tree might vary in the lifeworlds of those which perceive it. Tone is an interesting aspect to consider, as our inter-ractions and inter-reactions with any object, place or thing, can be very different depending on the factors that entangle and drive our tone, with tone being the drive or framing of *how* we perceive each situation, object or person. Uexküll proposed that dependent on their biological structure, species and individuals focus upon specific environmental features (perception-markers) *and their response to that focus (effect-marks*) which connect creating a *Functional Cycle (*Uexküll, O'Neill, Sagan, & Winthrop-Young 2010). This Functional Cycle, is driven not only by perception but also action, creating a tone in which an individual dwells. To better comprehend how the tone of a lifeworld drives forward behaviour and reality of an individual, Uexküll (2010) gives an example of an oak tree and how it appears different in different lifeworlds, depending on the *tone* and assemblage of the constructs that co-create each functional cycle and therefore each lifeworld. The object (oak tree) appears differently in the lifeworld of the forester who must consider which parts would be best to fell, ignoring other aspects of the oak tree which are dominant focus points for other lifeworlds. To the child, the oak tree resembles a human face and it quickly becomes 'a dangerous demon' in a magical environment. To the fox, the oak tree becomes 'protection' as it burrows into the roots. Uexküll (2010) suggests that the oak tree takes on different *perception-markers* - a process of phenomenological reduction - in different minds, altering the way in which it is perceived and interacted with. Each perceptive-marker works in accordance with a specific effect-mark (action). However, Uexküll emphasises that this cycle occurs symbiotically between perception and action.

> 'In the hundred different environments of its inhabitants, the oak plays an ever-changing role as object, sometimes with some parts, sometimes with

> others. The parts are alternately large and small. Its' wood is both hard and soft; it serves for attack and for defence'.
>
> (Uexküll 2010 p 132)

Uexküll highlights that the tree holds a non-fixed perceptive-marker – it always remains as a *potential* rather than *actual* object. For Uexküll, the oak tree becomes an *abstraction* which is affect-framed by the *tone* of a lifeworld, which allows it to become different things to different individuals depending on the *tone* and specificity of their lifeworld. These *tones* give meaning to each abstraction and perpetuate a dwelling space which becomes the individuals' lifeworld – a timely meshwork of the progressive entanglements of an individuals' lifeworld. In relation to Uexkull's meaning-tones in an individuals' lifeworld, it is important to note that there must be *flexible sign relations* within the individuals' lifeworld (Kull, Magnus and Linask 2015) and this is particularly noticeable with children who are still navigating within an 'adult world', but are still negotiating the rules and expectations thrust upon them in their own developmental child or adolescent world.

> 'The subjective universe of the animal is always the relationship between the subject and its object within the environment, and the perceiving and acting organism is always engaged in its environment according to its needs'
>
> (Kull, Magnus and Linask 2015 p 192)

It is significant to note that the individual cannot disentangle itself from its environment (of productive and progressive entanglements) and also that the individual is also driven by its own emergent needs. For this to happen Kull et al. (2015 p 192) state (with reference to Uexkull) that learners must '…first examine their own…[lifeworld]… and organization of their sensory and motor organs in their interaction, before making statements about the subjects they observe'. In terms of education, this highlights the very important and urgent need for teachers to firstly, examine their own productive and progressive perceptions and secondly, to better understand their own lifeworld. This must be acknowledged prior to creating a learning experience for another, particularly children and adolescents whom differ greatly in terms of the life-spaces they construct and live in (Farouk & Edwards 2020, Muchow, Mey & Gunther 2015).

3.5) Environment and the (co)creation of a Lifeworld

A large focus of Uexkull's Umwelt work involves an individuals' *Environment,* which Uexküll defined as a space made up of multiple functional cycles, where the

functional cycle mirrors the complexity and specificity of its' subject and is of influence and utmost importance (Uexküll, O'Neill, Sagan, & Winthrop-Young 2010). The environment is created from a collection of multiple lifeworlds or productive entanglements (abstract and concrete) where the transactions each form a 'The Functional Cycle'. It is these transactions, through the entangled meshwork of objects, forces, and things that allow an individual being to bring forth a third aspect – their lived-reality - 'lifeworld' (see Uexküll, O'Neill, Sagan, & Winthrop-Young 2010). This can be understood as 'autopoiesis' (Varela et al. 2001) as the being brings forth something that did not previously exist (their lived reality - lifeworld) but also through correspondence with its environment and relations, it is able to co-construct an ecological process of becoming (sustained growth). Poiesis is a dynamic process of correspondence and ecological becoming, which will be developed through this article. For Uexküll, the poiesis of an individuals' life-world occupies a specific *tone* that develops (and continues to develop) differently for each individual being.

In relation to instability in contemporary *environments* (Tønnessen 2003, 2009) also known as 'dancing landscapes 'which give rise to complexity (Page 2009), these in turn create rapid shifts in ontological states as the functional cycles may be intermittently intercepted by shifting perception-marks and effect-marks. Such an example can be understood in relation to navigating different spaces that require different judgements and values, spaces which are not fixed, but rather undergo continual cycles of unpredictable change such as social-media and the rapid expansion of technoetics (Floridi 2015, Ascott, Bast, Fiel, Jahrmann, and Schnell 2008). These newly formed and forming dynamic spaces impact the functional cycles in very different ways as the spatial and temporal navigation is not fixed. It is interesting to note that despite the progressive advancements and developments of science and technology, the autopoietic nature of the contemporary lifeworld can only be understood in relation to the developing structures that perpetuate it, which now include dominant technoetic influences. This paper considers updating and extending Uexküll's lifeworld model, to consider instability of dynamic hyperconnected and technological contemporary environments. If this idea is considered in relation to the way in which an individuals' perception informs their reality, then it can be understood that the developing minds of adolescents could be driven by different factors than adults as they *consume* and *create*/produce their lifeworlds in different ways depending on their 'tone' and entanglements, (see Muchow 2015, Ingold 2000, Piaget 2001 and 2000, Arnheim 1947) even if some of the stands of influence are shared. The poiesis of such can be very different and thus will demand a different approach in aiding the navigation of the emergent properties that form between these different developing relations.

Over the course of a century or more, Uexkull's ideas have developed (Muchow 1934/2015, Ihde 1990, Varela, Thompson & Rosch 1991, Haraway 2016) and complexified. By our time 'lifeworld' has become extended to a global scale. Hyperconnectivity (Floridi 2015) has increased complexity in contemporary globally connected-landscapes which under-go rapid cycles of change – also referred to as 'dancing landscapes' (Page 2009) due to the constant shifting and fluctuations of 'becoming-with' in a complex, hyperconnected era. Haraway's (2016) concept of *symbiogenesis* (2016) presents an analysis in which life-lived becomes a tangled meshwork of sympoeitic structures - a field perhaps, of strongly and weakly interacting forces that co-influence and co-construct our emergent ontological progression. This way of self-understanding suspends the existence of a singular reality recognising instead a mutable momentary collision where development occurs in any individual being or as Haraway (2016) puts it; a process of continual symbiogenesis – the becoming-with – a shared reality, rather than becoming (solely) individually. This idea extends the entangled reality of Heidegger's *'being-in*-the-world' (1967) by placing emphasis on *becoming-with*-the-world (Haraway 2016).

4) SYMBIOGENESIS AND SYMPOIESIS: PEDAGOGICAL DEVELOPMENTS REQUIRED FOR POIETIC SYSTEMS

> *Sympoiesis* as "collectively-producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components".
>
> *Sympoiesis* as referred to by Haraway (2016, p 33)
> based on environmentalist M. Beth Dempster's terminology (1998).

This definition, despite being over a decade old, highlights the shift in societal behaviours and global-communication of today. The acceleration of technological mediation (through rapid advancements such as the internet and social media platforms) appears to have rapidly increased the amount of information we consume and 'become-with'. Giddens' structuralism (Lamsal, M. 2012) is helpful in considering how these entanglements are productively developing the means by which our social and cultural stratas and routines are held in place, informing our development. However, Haraway (2016) places less emphasis on human-agency, and develops a wider, holistic understanding of how *non-human* forces have just as much agency with shaping eco-systems and thoughts. In relation to Haraway's reference to *sympoiesis*, this concept sheds light on how systems might be better considered in such an era. Information and control systems such as educational

institutes would benefit from re-considering their position in relation to how they co-form and promote ways of thinking, abstracting and becoming. In an era where information is available at the touch of a button, distribution and comprehension of information become a different issue than previously understood (Floridi 2015). To better understand the complex meshwork of symbiogenesis (Haraway 2016), it is helpful to consider this symbiotic co-constructive dependence through a *life-world* model that allows for an enactive analysis to be read. Pedagogy needs to develop an awareness of how tones of adolescent lifeworlds inform, co-form and transform adolescent reality and learning (Mille et al., 2016, Sharples et al. 2015). A lifeworld model of pedagogy or a *pedagogy of poiesis*, can be used to suitably abstract the sympoeitic nature of the contemporary teen by rendering visible the developing, timely and entangled ontology. A materialised lifeworld allows each individual to begin to question the way in which it is constructed and entangled as it renders visible the timely *metaplasticity.* It is possible to read this concreated thinking through an enactive approach, which could be used to analyse individual adolescent metaplasticity and develop pedagogy that can have maximum impact on facilitating learning (as it will be framed individually in a way that targets specifics of each students' entanglements).

Further research into adolescent abstraction processes would benefit this development by considering the process of abstraction, not as outcome, but rather as a process of ontological rendering. Such processes are often used in arts practices, where material *matters* the developing perceptions of artists by making them visible and therefore more tangible.

5) CONCLUSION

Technology has always been a disruptive influence that drastically alters systems and habits (Ascott, Bast, Fiel, Jahrmann, and Schnell 2008, Wang, Tucker, Haines, 2012). An urgent departure from dualistic philosophical ideas in education needs to be further considered as children and teens are not living *in* two separate worlds – they live *between* the emergent world co-constructed between the cyber and material – the socio-technical world (Beavis, 2013) If abstract entanglements and complexity are better considered in relation to a developing globalized, technological and hyperconnected society, then it can be understood that both the teacher and student co-create the learning process which becomes and emergent property of co-communication and co-development for both teacher and student alike (Matheson, R. & Sutcliffe, M. 2017, Ryan, A. and Tilbury, D. 2013). It is imperative that we consider the implications of the worlds we co-construct as the emergence of such perpetuate the ontology and ecology of future generations. As Haraway (2016, p35) states 'It matters what thoughts think

thoughts…[and what thoughts we don't think]…It matters what knowledges knows knowledges… [and whose knowledges we don't know]…it matters what stories tell stories…[and whose stories we don't tell]'. If education shifts towards an enacted techno-poietic model, this would alter the way in which we think about learning and curriculum design. It would be far more beneficial to develop our students with an awareness that spans beyond metacognitive comprehension, and informs the means by which they comprehend their own entanglements. This in turn would develop an informed agency to better impact not only metacognitive ability, but development of a successful pedagogy that does not out-date but rather un-tangles the complexities of ontology in each era.

As Donna Haraway (2016, p 35) acknowledges;

'It matters what thoughts think thoughts.
It matters what knowledges knows knowledges.
It matters what relations relate relations.
It matters what worlds world worlds'

And I would like to add that; it also matters what (and how) we teach and develop our students, as in turn they shape the way in which society evolves in relation to its' productive entanglements.

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