

Embodied (Learning) Experience and Augmented Reality

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Abstract

In the wake of continuing digitalization of everyday life, including the school and other educational institutions, Augmented Reality (AR), is one of the latest technical innovations that promise to improve education both in terms of providing faster access to information and, more importantly, by enhancing the learning experience. But, do *extended experiences* differ from what we might otherwise call ordinary world-experience? Is the perceptual experience using AR *fundamentally* different from the non-medialized/augmented experience? And under what conditions is the use of AR technology conceivable and sensible in educational contexts? In addressing these questions, we will first trace some main lines of phenomenological accounts of perception: intentionality, horizontality, intercorporeality (Part 2). Subsequently, we will discuss the question of whether AR not only changes perception, but also the lifeworld of its users at the same time (Part 3). In part 4, we will discuss possible consequences for the use of AR in educational contexts.

Keywords: Augmented Reality, AR, Learning as Experience, Passive Synthesis

Introduction

Augmented Reality (AR) technology is on the rise. This technical innovation, as the name suggests, superimposes digital images onto our previously unaffected view of the world – be it as a speedometer and satnav instructions that are beamed onto a car's windshield or as one of an ever-growing set of mobile apps for smartphones and tablets.

Expectedly, this technology is one of the latest innovations that promise to improve education both in terms of providing faster access to information and, more importantly, by enhancing the learning experience. Smithsonian National Museum's *Skins & Bones* app for example lets users see how the exhibited dinosaur skeletons would have looked like in flesh and blood, superimposing rendered images of how science imagines the appearance of various dinosaurs and their specific features from leathery skin to scales and spikes.¹ Other well-known examples of AR apps include *Pokémon Go* which mixes the imaginary world of Pokémon with real places as hunting grounds and *IKEA Place* that gives you an idea of how certain furniture would look like in one's own place. In other words, AR technology mixes the physical with the virtual.

AR is therefore distinct from what is known as *Virtual Reality* (VR). This term, coined in 1982 by Science Fiction author Damien Broderick, describes a computer-generated artificial environment that allows for interaction with said environment and which is, in principle, distinct from *physical reality* (PR). One well-known example is the flight simulator, which simulates alternative realities in such detail that pilots can now complete their compulsory flying lessons and parts of their training without 'real' airtime.

Both technologies, VR and AR, rely heavily on the use of technology. VR aims to provide complete immersion in the virtual world it depicts. This usually requires the use of expensive technology in the form of VR glasses, tactile gloves, body sensors, etc. AR, on the other hand, requires only minimal technological investment on the users' end. In most cases a wearable device such as a smartphone is sufficient. However, this obscures the fact that an enormous amount of programming and implementation work goes into these apps behind the scenes. Very few teachers have a technical understanding of how this technology works, and it is even less likely that independent third-party verification of the source code (open-source principle) is possible.² Consequently, the affirmation of AR technologies in schools increases the dependence on EdTech providers who distribute the corresponding learning software.³

¹ Cf. <https://naturalhistory.si.edu/exhibits/bone-hall> (31 May 2024).

² This essay does not discuss the mediality of AR technology as a particularity in an educational context. It goes without saying that even in schools with deliberately low levels of technical equipment (such as Steiner schools), we cannot do without teaching materials. These range from blackboards, worksheets, and textbooks in the classroom and vaulting horses in PE to Erlenmeyer flasks and Bunsen burners in chemistry lessons. It would be extremely appealing to explore the mediality of AR glasses and smartphones, which appear as objects in themselves, but at the same time have the power to transform objects and the world as we see them – as we will expand on below.

³ This paper is a thoroughly updated and revised version of a presentation that was first given at the *Lived Body – Corporeality – Embodiment* conference at Humboldt Berlin, 2017 and subsequently published in German in the according proceedings (cf. McGuirk & Buck, 2019).

Both Apple's and Google's app platforms are awash with AR apps which are specifically designed for classroom use and which cover everything from the blood and organs within us (anatomy) to the starry skies above us. But the use of AR technology in education is not just a commercial venture, it is also highly subsidized by governments all over the world who have begun to fund the development of AR environments for educational purposes, e.g. the "EdSim Challenge" funded by the US Department of Education aiming at "next-generation educational simulations that strengthen career and technical skills"⁴. University of Cambridge has started a cooperation with publishing house Ludenso to foster Augmented Reality textbooks "for the seamless creation and use of AR experiences which can help include visual learners and spark excitement in STEM learning, arts, history and anatomy"⁵.

While virtual reality worlds are by definition separate from physical reality, augmented reality aims to *mix* or expand unmediated experience with mediated experience.⁶ The degree of this blending of physical and virtual worlds varies from case to case, but it is undisputed that the blurring of the boundary between the worlds mentioned is central and at the same time arbitrary. It is both dependent on what creators of AR tech deem an appropriate mix between physical and virtual and what users *accept* as reality.

Besides countless studies on the impact and effectiveness of VR and AR technologies on learning outcomes, this central issue of blurring boundaries has been occasionally discussed within educational technology studies (Ariso, 2017).⁷ Our phenomenological perspective, however, puts the perceptual challenge of AR technology and its intricate ramifications for educational processes to the forefront (cf. O'Shiel 2022).

Especially against the background of other experiences that do not take place in physical reality (such as dreams, imaginative flights of fancy, memories, etc.), the question arises as to whether and to what extent such (technically) *extended experiences* differ from what we might otherwise call ordinary world-experience. Is the perceptual experience using AR fundamentally different from the non-medialized/augmented experience? And: Under what conditions is the use of AR technology conceivable and sensible in educational contexts? In order to pursue these questions, we will first trace some main lines of phenomenological accounts of perceptions (Part 2). Subsequently, some problems and questions will be discussed that revolve around the question of whether AR not only changes perception, but also the lifeworld of its users at the same time (Part 3). Finally, in

⁴ <https://www.edsimchallenge.com/>

⁵ <https://www.cambridge.org/partnership/research/transforming-the-student-experience-with-augmented-reality-textbooks>

⁶ Augmentation has a consistently positive connotation in English. Its meaning ranges from supplement to extension to increase/enhancement/increase.

⁷ This is not to dismiss the plurality of new fields of research due to technological advancements, e.g. regarding the increasing economization and standardisation of education practice and policies (Curtis et al., 2024; Nichols & Dixon-Román 2024).

the last part (4), possible consequences for the use of AR in educational contexts will be discussed.⁸

Phenomenological Perspectives on Perception

While Phenomenology is a ‘style of thinking’ (Brinkmann, 2015b, p. 2) that can, in principle, train its focus on any aspect of world experience, it is nevertheless remarkable that analyses of perception have tended to dominate a great many of the original texts of phenomenology (Merleau-Ponty, 1964; 2005; Schapp, 2013; Husserl, 1907). The privileged place of perception in the phenomenological corpus is evident not only in the studies devoted to it (Merleau-Ponty, 1945; Husserl, 1907), but equally in the ubiquitous use of perceptual examples as pedagogical vehicles for conveying the meaning of the phenomenological perspective (Hua XIX/2, p. 573).

One possible reason for the focus on perception within phenomenology – apart from Husserl and Merleau-Ponty’s obvious interest in it – is that it is excellently suited to explicating the meaning and importance of the concept of *intentionality*. In other words, the commonplace that consciousness is always consciousness *of* something is best grasped when explicated through the kind of encounter between an environment and a meaning-giving subject that occurs in ordinary cases of perceptual experience.

Now, of course, the analysis of perception turns out to be enormously complex from the phenomenological point of view. Yes, perception occurs in the encounter between the perceiving subject and the given object, but its structure can only fully be articulated in the light of phenomenological analyses of concepts such as horizontality, and embodiment.

It is a central tenet of Phenomenology that all world experience takes place within horizons of experience. A given object appears, that is, as a unity within a variety of possible experiences. The front and back of a sheet of paper, for example, offer two very different perspectives on what is ultimately given as a single object. The multiplicity of perspectives comprises an inner horizon through which a unitary object is given in my experience. However, this complex inner horizon of the given is itself embedded in an even more complex outer horizon in the sense that the object itself appears against a background, which determines and is determined by the meaning of the given. Phenomena thus reveal themselves in a certain fluidity between foreground and background; this will be discussed in more detail in Part 3.

⁸ We would like to thank Malte Brinkmann, Joris Vlieghe, Severin Sales Rödel and Käte Meyer-Drawe for their numerous productive comments and feedback.

Similarly, Husserl (e.g. Hua IV, p. 158; Hua XIV, p. 302), Merleau-Ponty (e.g. 2005), Stein (1917, pp. 44-63), Meyer-Drawe (e.g. 2018a; 2018b) and others, tell us that embodiment is fundamental to world constitution, while the appearance of objects is traceable to the capacities of the living body and its kinaesthetic powers of disclosure. This means that our perception of the world is essentially bound to our body (and its form), to its position in space, to the body schema and the associated possibilities of movement. This is true at the macro-level of complex bodily movements, but also at the micro-level. The eye, for example, is not a static receiver of external stimuli but an active organ that, through its saccadic movements, ‘feels’ objects and explores environments in recognizing contours, profiles, and relations. (cf. Merleau-Ponty, 2005, pp. 30 et seqq.; Noë, 2004).

For Merleau-Ponty, for example, there is no way of making sense of perceptual experience except by starting with the living, situated, embodied subject. Amongst the most important implications of this is the idea that to perceive is not primarily about visual beholding, but about corporeal engagement. Indeed, his analyses indicate that objects are given in our pre-reflective experience not as discrete objects of vision, but as *affordances* to act and be acted upon. Thus, for example, the keys on a keyboard do not appear as 40 separate buttons, but as a complex matrix that corresponds with the ability of our fingers to move in the act of meaning-making. This emphasis on embodiment has proven enormously fruitful, re-appearing as it does in various guises, from James Gibson’s idea of affordances (Gibson, 1966) to recent work on 4E cognition and the idea that perceptual landscapes are not merely the cognate of meaning-giving intentionalities, but of active engagement through which the body and the environment co-constitute or co-create (Gallagher, 2005; De Jaegher & Di Paolo, 2007).

While there is much more that could be said on these matters, it suffices for present purposes to note that 1) perception is bound to an embodied subject and thus the body represents the zero point for any possible perception (Hua IV, p. 158); and 2) that the phenomenology of perception is not primarily about psychology, but about ontology (in terms of environmental affordances and embodied capacities).⁹ As our primordial access to the world, perception forms the basis of our capacity to have experience, to know, and to encounter others. In this sense, the phenomenologists’ interest in perception is justified by reference to the idea that the study of perception is not the study of a domain of the world, but of the very capacity to *have* a world (Sokolowski, 2000).¹⁰

⁹ We owe this clarification to one of our anonymous reviewers: While psychology first and foremost tries to explain phenomena from within one’s individual mental constitution under laws of nature, phenomenology transcends the borders of solipsism to explore phenomena that are seemingly bound to an individual, but rather contingent on interindividual dynamics. It is thus, in the narrow sense of the word, a social science.

¹⁰ Bernhard Waldenfels (2020) developed a phenomenology of responsivity, which also draws from this idea. For the sake of coherence, this has to remain a side note here.

What are the educational consequences for these insights? Firstly, if the body, embodied experience, and intercorporeality are central for educational processes such as teaching, our attention should be paid to *how* bodies and embodiment change in the context of virtualisation and augmentation. How does the embodied zero point change and what challenges does this change pose for educators (Willatt & Flores, 2022)? And secondly, if our mode of experiencing changes with the increasing implementation of VR and AR technologies, what does this entail for ontological and epistemological questions. In other words: How does AR use in education change what we consider truth? Our suspicion implies that AR potentially not only affects aesthetic dimensions of education (pathos), but also normative dimensions (ethos).

Three Clarifications Regarding Augmented Reality and Perception

In what follows, we wish to explicate some implications of the foregoing phenomenological insights for how we should understand AR as a modification of perpetual and lifeworld experience. These implications will be cashed under the rubrics of, 1) the problem of artificial transformation of the environment; 2) the role of embodiment; and 3) the mode of perceptual attention within AR. As will be shown, these three points are interconnected and point to interesting discrepancies and discontinuities with conventional forms of perception, which in turn entail unexpected consequences for lifeworld experience.

The Problem of Artificial Transformation of The Environment

The first of the three clarifications is possibly the least problematic. It concerns the way in which AR introduces non-real elements into the perceived landscape and thus changes what is given in perception. With the help of an IKEA app, for example, any room in my house can become the background/context for the placement of a piece of Scandinavian furniture. As such, the inserted element transforms the field of perception by introducing virtual objects that alter the *meaning* of what is perceived.

But are such alterations really so revolutionary? After all, augmentations of the landscape that transform the perceptual space have been commonplace long before the advent of AR. Consider how the simple addition of white lines turns a grassy plain into a football pitch. Suddenly the field is no longer just a field, but a ‘field of action’ delimited by lines and their symbolic content (cf. Merleau-Ponty, 1963, pp. 114; 203). This example is famously elaborated in Merleau-Ponty’s early work *The Structure of Behavior* (1963). There, he argues that the boundaries of the football pitch not only have a transformative effect on what lies outside them, but also on what is enclosed by them. The transformation is, so to speak, both internally and externally operative (Merleau-Ponty,

1963, pp. 185 et seqq.): externally insofar as the field as a whole is separated from everything that lies outside of it and thus creates its meaning as a field of play. Internally, the various lines constitute possibilities, injunctions, and prohibitions of action, which in turn are determined by and determinative for perception.

One of the insights this example reveals is that human beings are essentially landscape transformers. We don't simply respond to our environment as it gives itself, but also transform the meaningful import of spaces in order to make these spaces more habitable or more suited to our designs. We adapt our environment to ourselves every bit as much as we adapt ourselves to our environment. This is clear even in this relatively trivial example of transformation for the purposes of leisure.

Besides the technical difference between the transformation of a meadow into a football pitch using chalk lines and a transformation using AR technology, which leaves no traces in physical space, it might seem that the differences between the two cases are quite minimal. After all, both the chalk and the AR involve reconfigurations of the environment that then transform the meaning of the perceptual field. Having said this, it is noteworthy that Merleau-Ponty's example involves an intervention that is first and foremost practical and action-directing, while the AR example is very much rooted in abstract visual beholding. We will return to this point in 3.3.

The Role of Embodiment

The second point is more challenging, though paradoxically so. The issue here has less to do with the fact *that* the environment is transformed and more to do with the *kind* of object with which the transformation takes place. Here the claim is that AR introduces paradoxical features into the environment that are inconsistent with ordinary perception and which produce a sense of misalignment in the normal flow of bodily constitution.¹¹

On the basis of our first objection, we note, and concede, that the phrase 'inconsistent with ordinary perception' cannot be taken as a synonym for 'artificial'. The example of the football pitch – and there are many others – demonstrates the extent to which artificial transformations of the environment are a perfectly 'natural' aspect of ordinary human perception and action. We transform the environment all the time and such transformations, as we have seen, can also determine the way we perceive the environment. If we are to accuse AR of inconsistency, then, we will need to understand this notion in broader terms than merely the artificial.

¹¹ We note at this point that the reflections on body-bound perception are among the most important within the phenomenological literature on perception in general. This applies not only to Merleau-Ponty, but also to Husserl, who devoted large parts of *Ideas II* (Hua IV) and the 1907 lectures entitled "Thing and Space" ("Ding und Raum", Hua XVI) to spatial perception and embodiment.

And indeed, criticism from the point of view of bodily constitution may initially seem odd here. After all, isn't the central merit of AR precisely the fact that it elegantly integrates technology into the kinaesthetic perception patterns of the human body? In AR, we do not encounter flat, two-dimensional images, but three-dimensional elements in real space, that offer different aspects and perspectives that correspond to the movement and position of the body. We can walk around an object, such as a piece of seating furniture, and view it from above or below as if it were 'really there'. It would make sense to speak of a feeling of jarring incoherence if these objects were only displayed as two-dimensional, but this is not the case. Quite the opposite: AR integrates objects as three-dimensional objects in space in such a way that they appear to provide exactly the same affordances as real objects do.

Or do they? On closer analysis, this turns out to be less certain. For all its three-dimensionality, there persists a profound shallowness in the givenness of the AR object vis-à-vis non-medial objects. Here, we have in mind Merleau-Ponty's subtle analysis of the synaesthetic depth of ordinary perceptual objects, a depth that is often belied in our ordinary ways of describing what we see (Merleau-Ponty, 2005, p. 268). As Merleau-Ponty deftly shows, the table I see in front of me is not only given as a three-dimensional and brown object (extended and coloured), but also as smooth and hard. Similarly, a glass of beer is perceived not only in terms of shape and colour, but also in terms of temperature and even taste. In other words: non-medialized perception is multi-layered and multi-sensory, and while we often talk about objects as if they were offered only to one sense of perception ("I hear thunder", "I see a tree", "I taste a strawberry"), phenomenological analysis reveals them actually to be given to the full range of possible bodily orientations towards them. In other words, the givenness of the object involves multiple possible dimensions of interaction between the object of the world and the pre-reflective unity of a corporeal or always already corporealized subject. This is not the case with augmented elements, since these usually only reveal themselves to the sense of sight, albeit a three-dimensional and therefore more robust modality of vision. We can circle around an augmented seat or traverse an AR obstacle course, but these objects never manifest themselves in any way other than visually. In this sense, augmented objects lack the textured depth that we can draw on in our usual perception. In comparison, they are *reduced* or *poor* in the way they are given.¹²

At this point, we might refer back to the previous example of the lines on the football pitch, which are apparently as thin or thinner in terms of what they give to bodily perception. The chalk lines on the football pitch are, we noted, physical transformations or augmentations of perceptual landscapes yet offer little by way of embodied resistance.

¹² After reading the manuscript, Käte Meyer-Drawe rightly referred to Merleau-Ponty's connection between perception and imagination, which needs to be rethought with regard to AR and VR. There may even be a heightened imagination through the reduction of sensory impressions to the visual. This would be one of many possibilities for empirical research from a phenomenological perspective in this area.

They do not obstruct my field of view nor do they make me stumble when I cross them. They remain, therefore, an imaginary object. But a closer inspection of the matter reveals an important disanalogy between the two cases. The lines of the football pitch are to be distinguished from AR objects because they are not objects at all, but in their primary function shift the boundaries of what is perceived. In other words, the striker on the football pitch does not concentrate on the lines that delimit the pitch, but on what they allow and forbid him to do. The presence of the lines legitimizes or delegitimizes certain actions that would appear senseless or absurd in a similar space without these lines. AR objects, on the other hand, *are* objects of attention and perception, be they a piece of furniture, a Pokémon or a dinosaur skeleton. They are not augmentations that enframe possibilities of perception and action, but quasi-objects that offer themselves as points of focal attention and influences on how I perceive and move through the world.

The Mode of Perceptual Attention in AR

We imagine a protest at this point that our critique is too harsh. The objector would ask us to note that while AR elements certainly do reduce perceptions in their reality, the technology is, after all, still in its infancy. Its current applications were unthinkable just a few years ago. And so, it is conceivable that in the near or not so near future, AR elements will exert sensory stimuli in such a way that it will hardly or no longer be possible to distinguish between real and simulated. But, this brings us to our third point, which we have termed the mode of perceptual attention afforded by augmented reality, which we feel is the biggest question mark hanging over AR in its current form. This objection concerns lifeworld orientation in general more than perception specifically. In order to explain what we mean by this, it is necessary to make a brief detour into Husserl's work on passive synthesis (Hua XI). Passive synthesis refers to the processes through which the meaningful essences and structures of experience come to be formed over time. They deal not only with how the world *is* constituted, but *how it comes to be* constituted. In this sense, these analyses are relevant not only for phenomenology, but also for a philosophy of pedagogy.

Husserl's work on passive synthesis – after about 1920 – is in no way a repudiation of his earlier work, but rather an acknowledgement of the incompleteness of that work as providing an adequate account of the constitution of meaning in experience. He remains committed to the fundamental concepts of phenomenology – *intentionality, horizon, epoché, reduction, noesis, noema*, and to the project of articulating the taken for granted essences that furnish ordinary, everyday life. The point of his work was always, as Adolf Reinach puts it, to make contemplatively transparent what is only operationally transparent in ordinary practical comportments (Reinach, 2002).

After 1920, however, Husserl came to view the eidetic science of consciousness as only one part of the phenomenological project. It is of course important to provide such an

articulation of essences, but this project only described the constitution of meaning as already achieved by intentionality. This – what Husserl called static phenomenology – needed, in other words, to be supplemented by a deeper-going genetic phenomenology, which laid hold of the emergence of sense. Husserl writes:

There is still much more that is lacking, namely the reference back to the phenomenological primordial sources of all knowledge, the deepest founding of all objective sciences arising from the universality of knowing consciousness. Thus, lacking is a systematic fundamental science that would provide an ultimate understanding of all theory arising from the originally sense-giving sources of the subjectivity that accomplishes knowledge. (Hua XI, p. 353; Husserl, 2001, p. 5)

He realized that every meaning at the static level has a (hi)story of genesis, a facticity or passive givenness *without* any active participation by the ego (Zahavi, 2002; Hua XI). This means that meaning at the static level is not reducible to subjectivity but rooted in the complex encounter between embodied subject, object, and horizon.

The point of passive synthesis, then, is that the story of the emergence of meaning is a complex one, owing as much to structures that draw us into engagement with the world as to the engagement of the subject. The end product of this process is the essences that furnish the lifeworld. While we cannot treat this issue exhaustively here, it might be worthwhile to mention one or two of the features of passive synthesis as described by Husserl in *Husserliana XI*.

Passive synthesis takes place at the level of sensibility and is described by Husserl as the pre-givenness of the world. This notion of pre-givenness (*Vorgegebenheit*) is difficult but seems essentially to refer to an aesthetic dimension in experience that motivates the upsurge of sense prior to any initiative on the I's part in the direction of grasping specific meanings. This is not to say that I am a merely passive recipient of finished meanings that just manifest themselves to me. Meanings are not just given as finished in experience.¹³ They are first formed in the encounter between the aesthetic dimension of the world and the embodied, situated nature of the subject. This is, then, a very integrative approach based on the object's integrity, the history of the individual consciousness, as well as the capacities (I can) of embodied consciousness. In short, it concerns the habituation of consciousness and its capacity to attend to patterns of meaning in its lifeworld (McGuirk, 2023).

¹³ As Anthony Steinbock puts it, passive synthesis appeals “both to the Greek *aesthesis*, and the constitution of spatio-temporal nexus through the kinaesthetic character of experience” (Steinbock, 2001, p. xli).

It is in the stream of consciousness that certain regularities begin to emerge for us, which over time, stand out as significant unities of experience. In regard to this, Husserl speaks of memory and association (Husserl, 2001, p. 637-8; 642) and also of ‘affective allure’ (*Reiz*) which seems to designate a motivational solicitation coming from the object which leads me eventually to turn towards it in an attitude of thematic attentiveness. It is at this point that active synthesis and the more robust work of the ego comes into play in the sense that objects are attended to as discrete objects of interest. It is important to be clear here that this process of an emergent attending to the object is not equivalent of the theoretical attitude described in the earlier writings or of Heideggerian presence-at-hand. It is not about the transition to the phenomenological attitude that attends explicitly to what was taken for granted within the natural attitude. It is, rather, an attempt to describe how meaning emerges within the natural attitude in the first place. It is Husserl’s attempt to make sense of how perception is possible in the first place and how it comes to be structured in the way that it is. Now, this may seem an odd question to spill philosophical ink over, but on reflection, the point is crucial. Contrary to common sense theories of perception, our perceptual experience of the world is an accomplishment rather than a given. We know that at the level of pure sensation, there are an almost infinite number of things vying for my attention. The room in which I am currently sitting is comprised of a near infinity of data. There are any number of ‘givens’ and constellations of these that I might attend to. I might attend to the colour of the walls, the number of chairs, the air temperature etc. But attending to everything would be overwhelming and incomprehensible, so, in practice, almost all of the data that might be attended to is filtered out or pushed to the background in order for the overarching salience of the space to become manifest. That the world begins to emerge as differentiated and contoured is the result of the structures of passive synthesis that Husserl is here describing (Husserl, 2001, p. 632).

It is important to clarify here that passive synthesis is not to be taken as synonymous with interest. Husserl does not deny that our perceptual experience can be shaped by the interests we bring with us in concrete situations – a teacher entering a classroom might not attend to the number of chairs in the room, while a Maintenance employee might – but this is not his point. Passive synthesis remains essentially two-sided. The object, which begins to emerge as a meaning *for* consciousness, is not reducible *to* consciousness and cannot be summoned by consciousness whenever it pleases. As a result, Husserl does not define association as a purely subjective process, as Hume had done, since it is partly to be accounted for in terms of the integrity of the object. In other words, meaning is not the imposition of order on chaos by subjectivity, but the emergence of an ability to attend in an ordered way to what is there.

The point can be illustrated with an empirical example. Recent decades have seen tremendous strides in the treatment of congenital blindness in infants and the restoration of sight. Indeed, more recently, there appears to be grounds for hope that even teenagers

whose visual impairments are addressed can learn to see (Mukerjee, 2014). But these interventions are not straightforward. Removing the physical impediments to visual impressions is one thing. The cultivation of visual experience is something else.¹⁴ The subject needs to learn how to process visual impressions, so that they become coherent and dependable experiences, which is exactly the process that is at stake in passive synthesis. What these cases teach us is that perception as an emergent capacity that becomes more fine-grained over time in the encounter between the explorative senses and the self-revelation of the world (cf. Dörpinghaus, 2018, p. 459). One might argue that it is the task of any educational endeavor to facilitate an ever finer way of perceiving and understanding of the world.

While there is much more that could be said on the subject, we would like to stress here that *meaning*, according to Husserl in his lectures on passive synthesis, is emergent in experience on the basis of the allure of the world and the movement of the subject in it. It is the combination of movement, the past, the object, and its embeddedness that are formative of structural, coherent awareness. To perceive is to learn to attend so that discrete meanings can come to presence in the kind of attending that is characteristic of intellectual contemplation.

So what is the mode of attention of AR? We have already established that one of the advantages of AR is that it integrates virtual elements into our perceptual field by indexing their appearance (to an extent) with the body. However, we have also argued that this linkage is thin and prioritizes forms of encounter that are narrowly visual (2nd specification) and thematic (3rd specification). In the aforementioned examples, the AR elements function as given, non-negotiable foreground data against the background of the real, non-mediated world. According to Husserl's analysis of the centrality of passive synthesis in constitution, however, we note that what is central is not the dichotomy of artificial/real, but of emergent/fixed. That is to say that augmented reality invites a specific and premediated form of orientation to the world that precludes more than it reveals. It draws the world almost like a picture – albeit a picture that the subject can move around in – but it does not thereby enable the kind of dynamic integration of elements into the world that allows meaning to emerge in the sense of what is otherwise possible through passive synthesis. The augmented element does not emerge in the time of the subject, but rather pops into existence, literally from nowhere. As such, thematic and explicit object consciousness is not only prioritized, but uprooted from all other forms of world consciousness.

¹⁴ A curious case from antiquity is found in the Gospel of Mark (8:22-26) which tells the story of a blind man healed by Jesus. Initially, he reports seeing “men walking as trees”, which would indicate visual impressions that he has not learned to integrate as visual experience.

Our ordinary encounters with the world are sometimes thematic, but more often they are not. They are forms of practical, embodied, pre-reflective engagements with complex material and intersubjective environments in which patterned meanings are constituted and received long before they become thematic objects or landscapes of contemplation. Even the simple case of going for a walk demonstrates this. Taking a walk is not, for the most part, a thematic activity. I can do it absentmindedly, or with an instrumental purpose (to get to point B). Even, when there is a thematic focus, this may not be directly related to the walk as such. I may take a walk to mull over some problem alone or discuss it with a friend. But, the walk is also a way of exploring and mapping the world, even and especially when this is happening in the background of my conscious attention. The kind of marginal attention at stake in such activities is crucial to the emergence of the lifeworld as an overall context of sense. The central problem with AR is that it knows nothing of the margins of attention in this way, other than as absences of content. As an algorithmic model, it knows only foreground and will always seek to orient us towards the foreground of thematic attention. In this sense, AR pushes itself between the self and the world and thus cuts off the non-medialized possibility of passive synthesis a priori, including its ambiguities, experiences of strangeness, etc.¹⁵ But, it is precisely here that so much of world constitution and learning take place. Even when we turn to an object as an object of thematic attention, we do so because we have been motivated to attend to it from within a meaningful context or framework. Objects do not appear without frames of reference. If they did, we simply would not know what to make of them. So, the point here is not that AR poses a risk to learning by prioritizing thematic attention – after all, this is one of the central strategies of teaching – but by deracinating the thematic from the non-representational forms of awareness that undergird and make possible thematic attention in the first place.

Our criticism of AR is thus that, based on a false separation of medialized and non-medialized perception, it a) privileges a certain form of encounter with the world that b) short-circuits our ability to generate meaning. The passive synthetic moments of association, memory, stimulus, etc., through which meaning arises enable the emergence of patterned experience and the attraction objects to and for consciousness. When these are exchanged for pre-structured forms of perception, augmented reality decides what is to be perceived and how, while simultaneously untethering these perceptual data from a meaningful matrix. This not only means a situational curtailment of the freedom of the individual, but also threatens the long-term development of the ability to collect and vary

¹⁵ We owe the following clarification to Malte Brinkmann: such an argument based on a predetermined reduction of the meaning of modes of perception is already based on a responsive phenomenology of the body, which in part only emerged with the late Husserl, and in part only after and in distinction to him. The possibility of an ambiguous experience of strangeness in front of others, for example, does not yet present itself as a problem in Husserl's early work (i.e. before the transcendental turn in 1907, cf. Cobb-Stevens, 1990). Only against the background of social-theoretical implications, however, can we consider perceptual events in such a differentiated way that they can be appropriately connected to pedagogical questions (Brinkmann, 2016, 218 f.; Lippitz, 2003; Meyer-Drawe, 2001).

perceptual experiences and the refinement of meaning through the experiential, contradictory encounter with the world (vulgo: educational experience, cf. Humboldt, 1986; Blumberg, 2002; Dörpinghaus 2018). Such a gradual development of meaning, taking into account individual horizons of experience in the presence of others and negotiating with competing perspectives, may constitute the core task of pedagogical action. So what are the possible side effects of using AR in teaching and learning contexts?

Pedagogical Implications of Augmented Reality

Pedagogical-phenomenological theories that understand learning as experience (Meyer-Drawe, Brinkmann, Lippitz, Loch and others) struggle with the separation of normal and medialized experience assumed by concepts such as VR and AR. They operate with ideas of learning and education in the mode of passive synthesis and reject a direct presentation-reception relationship, as is inherent in VR and AR concepts. To further complicate this issue, visual perception has been a cornerstone for the most theories of learning and teaching. This insight can be traced through the history of educational theory. It was Johann Pestalozzi who placed observation at the center of his thinking and which even gave rise to the established term *Anschauungspädagogik*. Also worth mentioning is Klaus Mollenhauer's idea of aesthetic representation, picking up on the topos of *repraesentatio mundi* as teachers' central task (Mollenhauer, 2014). Klaus Prange's theory of showing (Prange, 2005; Biesta, 2022) is fundamentally based on the possibility of shared perception as a relationship to the world.¹⁶ What this entails is a possible influence on the ethical or normative dimension of pedagogical action, because showing and perceiving involves an implicit conveyance of what we as teachers assume to be *true* and therefore worthy of being taught. In a more political sense, *visions* are not only an inherent part of economic considerations and planning, but have also found their way into discussions about educational development, school development, etc. (Friesen 2020).

In order to adequately answer the question of what implications AR has for pedagogical events, we might profitably look to the thought of Malte Brinkmann, whose work on the nature of pedagogical (learning) experiences, gives concrete expression to some of the concerns we have been developing at a more theoretical level thus far. Following Brinkmann (2011; 2015a; 2015b; 2018; 2023), we assume that learning as an experience is always embedded in a thematic, social and world-related horizon (cf. Brinkmann, 2015a, p. 535; 2023), whereby the thematic horizon is usually determined by the subject matter or school curriculum. At least in Western cultures, the degree of thematic fixation is usually relatively high – a condition that seems advantageous for the use of AR in the classroom and other educational settings.

¹⁶ We owe this comment, which underscores the gravity of a changed possibility of perception for educational action, to Reviewer C, whom we would like to express our sincere thanks to here.

Brinkmann emphasizes three outstanding characteristics of learning experiences as constitutive. Learning experiences are always 1) the learning of *something* (it is impossible to learn how to learn without an object), 2) responsive to others and the other (human or object, present or not), thus neither mono- nor bidirectional in orientation but rather dynamic and finally 3) related to teaching in the sense that there is always a "pedagogical difference" (Prange, 2005) between teaching and learning that cannot be overcome in a technical manner. Teaching is therefore never the transmission of information from one individual to another, but a complex social practice that requires an understanding of the contingency and non-linearity of learning.

The concrete learning experience is then characterized by two properties (with reference to Husserl 1952;1966b, Gadamer, 1990; Buck 1989). Firstly, it is characterized by its intentionality as active-passive directionality or attentionality. It shows itself as a fundamental openness towards pre-reflective, pre- and non-verbal phenomena in the sense of one's own body as a "zero point" and "point of transition" (Hua IV, p. 158; 161) between ego and world. Secondly, learning experiences are always bound to their own horizontality in the sense that learning experiences are based on the subject's previous learning and life experiences. From this perspective, repetitions and iterative exercises may be the central pedagogical operations, as they are in a constant tension between habitualization and ruptures with the past and are therefore highly dependent on the experience of otherness/alienness in order to normalize the difference between subject and social meaning (cf. Brinkmann, 2012; Vlieghe, 2019).

Based on this, the power dimension of pedagogical action has to be considered. Pedagogical actions limit and normalize interventions in the sense that learning experiences in institutionalized settings always take place on a spectrum between compulsion and freedom, thus raising the question of how pedagogical situations can be created in which the horizon can be transformed through new orders, practices and habitualizations. One possible answer to this question may be found in the *negativity* of learning experiences (cf. Benner and English, 2004; Rödel, 2017), that is the disappointment of one's own expectations.

School settings are valuable because they allow us to provoke negative learning experiences by staging them (cf. Masschelein and Simons, 2013).¹⁷ Moreover, they enable the use of diverse (aesthetic, cognitive) stimuli and challenges. Using these, students are challenged to question their knowledge horizons, for example by defending their arguments in front of others in a semi-public space (which corresponds to Kant's

¹⁷ The idea that pedagogical experience is characterized by negativity, in the sense of resistance, is a central tenet of important strands of pedagogical research (Brinkmann; Buck; Masschelein & Simons). The issue is also critically assessed in recent contributions such as Brinkmann (2025) and McGuirk (2025) (both forthcoming).

idea of exercising reason). At the same time, the somewhat sobering result of Severin Sales Rödel's empirical research (2015; 2017; 2019) is that negative experiences can neither be produced technically nor in a reliable, repeated fashion in the classroom (cf. Rödel, 2018).

A radical difference between lifeworld and school experiences lies in the fact that staged school settings elude application to the real, other world (to the dismay of many pupils and parents alike). The benefit of the school as an institution lies precisely in its independence from criteria for success that lie beyond its walls. In other words, the organization of teaching settings that raise scientific questions based on the knowledge of the fixedness of the learning *object* and the simultaneous assumption of the changeability of the learning horizon of each individual learner. It is this very assumption that defines the specification of teacher action and at the same time points to its most important and irreplaceable function: the capacity for pedagogical judgment about the genesis of students' insight. This insight (or ability) is lost when it becomes impossible to differentiate between life-world and propaedeutic, academic, staged experiences (cf. Brinkmann, 2011, p. 65).

Losing this sense of difference and the possibility of pedagogical judgment would mean a loss in the sense that learners would no longer be able to adequately evaluate conflicting conditions and modes of experience; in the worst case, it would be tantamount to losing the ability to criticise at all. The form of the encounter between the world and one's own horizon within augmented environments would be determined in advance. This would potentially prevent the opportunity to restructure one's own horizon in a way that is not foreseen by the respective creator of the augmentation. The augmented interaction with the world is not real in the sense that it obstructs responsive perception and interaction in a broad sense – in favor of the demand for attention and pre-determination of perception mentioned in section 3.

When using AR, it is no longer the object that appears to be fixed, but the mode of presentation and problematization – if there is one to begin with. Complex and genetic modes of perception and changing horizons are leveled in favor of an anticipated strategy of the biggest or quickest learning output and the most promising perception of the world. At the same time, other modes of learning that are not particularly based on visual perception are neglected or, at worst, unlearned. Multisensory perception is abandoned in favor of a mode of perception that is then considered paradigmatic. In other words, there is a double didacticization: one that refers to the presenting media, one that focuses on experience and the subject.

Physical, pre-reflective dimensions of perception become unimportant for this distinctly cognitive and bodiless approach to learning – a paradoxical situation given the explicit focus on the body in the use of AR. It is no longer the body that represents the zero point,

it is the augmentation that users must submit to in a fashion that is rather uncritical and inevitably uncontested due to its opaque and premediated nature.

What is more, the difference between teaching and learning is potentially eroded by the use of AR. When used extensively, it undermines what we know about individual learning experiences and teaching, which is always dependent on a form of pedagogical judgment and appropriate learning scaffolds. Changing curricula, teachers' preferences, current examples all disappear against a pre-programmed order of what is to be perceived.

According to AR's underlying concept of learning, it is not something processual, but a desired product of precisely defined learning units with fixed start and end points, linear progressions and a uniform idea of the learner. As such, an embodied mode of responsiveness or even passive synthesis only disrupts the operational sequence of previously anticipated modes of perception and attention then. In order for it to work as intended, AR has to demand undivided attention and offers a meaning that cannot develop dynamically, ambiguously and possibly in disappointment.

Negativity of learning plays little or no role, as AR primarily functions in the mode of positivity due to its fundamentally static and predictable nature. Negativity only appears as a superficial moment of surprise to keep the motivation curve at a high level. Questioning the individual knowledge and learning horizon, on the other hand, is not part of the functional logic of AR. Of course, it is still the teacher's task to select and explain the methods used. However, the question remains as to what extent AR tempts teachers to favor a universal and less individualized and reflective approach to teaching.

With regard to the example of the dinosaurs mentioned at the beginning, the difference in processual sensitivity between conventional teaching and AR becomes clear. In traditional teaching settings, a teaching unit could begin with the discovery of fossils in order to ask what conclusions could be drawn about the living conditions of the animal found. How do we know when it lived? What did it feed on? What were the climatic conditions and what were its predators? These reconstructive methods in the classroom allow the integration of different knowledge horizons. The teacher can find out what previous knowledge exists and at the same time question it and introduce new knowledge. What is most important, however, is that this form of teaching allows (scientific!) reflection on the conditions under which knowledge is created and its validity, its change – for example through new discoveries or improved research methods – and its degree of certainty in the sense of a problematizing use of reason (Ruhloff, 1996).

However, with the use of AR, ever increasing mediality is given the primacy of attention. It presents a perfect reconstruction of what we consider to be certain knowledge today

and exerts its appeal through impressive graphic representations of what has long been extinct. However, the stimuli are limited to the sense of sight and the question arises as to whether the genesis of knowledge and its contexts of validity can be sufficiently problematized. This is a crucial point, as AR blurs the line between the reconstructed and the real just as much as it obstructs learning experiences in the mode of passive synthesis qua prefabricated designs.

The use of AR technologies is therefore not just a "new medium" that, like educational films or PowerPoint presentations, is finding its way into classrooms. AR entails implications that urgently require pedagogical support, questioning and contextualization, because modes of perception are at stake and require reflection on this in teacher education and training. In this sense, it should be noted that the use of AR in selected pedagogical contexts can certainly be considered beneficial and useful – for example in anatomy studies. There is also little reason to fear that redecorating a home with Swedish furniture will herald the doom of education. In schools or even pre-school institutions, on the other hand, the use of AR, especially from a bodily phenomenological perspective, should be approached with great caution before a habituation to a form of meaningfulness sets in, which may immunize itself against a genetic emergence of meaning and the practice of critical faculties. Assuming that learning is a physical, embodied experience, we therefore only share the enthusiasm of many advocates or education policy-makers regarding the far-reaching promise of salvation of augmented reality to a limited extent.

Conclusion

Of course, none of this is a general rejection of the use of AR in the classroom and other educational contexts. However, the points mentioned should be taken into account in contexts that aim at learning or even educational experiences and require a reflection on their own conditions of possibility (horizontalness, responsiveness, sociality, etc.). In other words, while AR enables a whole range of interesting and legitimate uses, there are serious objections regarding its use as an educational *passe-partout*. In the wake of Daniel O'Shiel's study (2022), it may be fruitful to conduct empirical phenomenological studies to investigate what is actually *concealed* by the act of showing something with the aid of digitally enhanced devices. At the same time, it seems to be overdue to deliberate about criteria according to which the use of AR technologies can be meaningful and beneficial for learning and educational processes without the hubris of anticipating students' comprehensive perceptions, experiences and conclusions.

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