Western Norway University of Applied Sciences

HVL-notat nr. 6 2024

From STEAM to… SENSE.STEAM. Re-acquainting ourselves with attentiveness.

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Funded by the European Union

Department of Sport, Food and Natural Sciences
Western Norway University of Applied Sciences

Høgskulen på Vestlandet
2024

Article 1 of the HVL-series on Art and Science in Education.

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HVL-notat frå Høgskulen på Vestlandet nr. 6-2024.

ISSN 2703-710X
ISBN 978-82-8461-073-3

Summary

This article is the first in a series on art and science in education. The text introduces the idea of integrating art and science in education, with a focus on two key points. Firstly, we examine the practical application of STEAM education and its implications for different communities. Secondly, we deep dive into the significance of attentiveness in human experience and education. We authors, who are science educators, recognize the difficulty of integrating spiritual, social, and political aspects into science education, as well as the perception of art as separate from everyday life. We suggest a notion of STEAM which goes beyond traditional subject categories, highlighting a comprehensive approach based on sensory experience and perception where the ”A” stands for attention and aesthetics based on the ancient Greek aisthesis, meaning sensation or perception.

KEYWORDS: art and science education, STEAM, attentiveness, transdisciplinarity, multiple epistemolgoies

Foreword

This contribution is the first publication of a new series reporting on ongoing developments, reflections and work in progress achieved in the EU funded Project SENSE. The new European Roadmap to STEAM education.

SENSE. The New European Roadmap to STEAM Education puts forward an art-integrative science education, grounded into a sensory and participatory approach to STEAM education. Taking the shape of a roadmap to creative and holistic STEAM learning to support todays's learners and educators, the SENSE.STEAM approach embeds sustainability, participation and social inclusion, creativity and inquiry at its core. This ambition will sustain the development of our New European Roadmap for STEAM Education building awareness, action, and advocacy for future-making STEAM education.

Albeit still a rather new concept in formal education, STEAM is gaining momentum around the globe and across multiple fields of educational practice, from early years to higher education.

Here we focus on two points, which are central to our project in SENSE.STEAM. First, we look at what it means to put STEAM education into practice in the real world, and what implications this may have for different communities. Secondly, we grapple with the question of attentiveness, especially in relation to our position as humans and the ways we attend to us and others in this world. As we are both science educators, we are aware that this shift may be challenging in education, as science subjects are typically not considered the place to understand matters that may be considered spiritual, social or political. Similarly, with the arts, there are issues with classical views of artistic practices as being exclusive or detached from the everyday lives of people.

What we want to suggest, then, is that it is important for us to look at the combination of STEM and the arts beyond their categorisation into curricular subjects. In this view, the 'A' in STEAM is more than just the arts, but refers to a way of experiencing and understanding the world that is grounded in the senses and gives impetus to directing our attention and perception in a holistic way.

We hope you enjoy reading this article.

Edinburgh and Bergen,

Laura Colucci-Gray and Lydia Schulze Heuling

From STEAM to… SENSE.STEAM - Re-acquainting ourselves with attentiveness, as the ability to sense-with and make-sense in communion with others.

Albeit still a rather new concept in formal education, STEAM is gaining momentum around the globe and across multiple fields of educational practice, from early years to higher education. Originally conceived of as STEM (Science, Technology, Engineering, and Mathematics) + Art, the STEAM acronym has become a proxy for a new economy, stemming from the hybridisation of design and the visual arts with computing and engineering to fuel product innovation, and meet market demands. In education, STEAM has paved the way for new curricula tailored for professionals such as architects, scientists and medics1. These curricula emphasise the development of motor coordination skills and the practical application of knowledge in real-world scenarios.2

However, while a multiplicity of STEAM configurations exists, the educational research community has not yet taken a stance on its merits or woes. And there are good reasons as to why this might be the case.

Here we focus on two points, which are central to our project in SENSE.STEAM. First, we look at what it means to put STEAM education *into practice* in the real world, and what implications this may have for different communities. Secondly, **we grapple with the question of attentiveness,** especially in relation to our position as humans and the ways we attend to us and others in this world. As we are both science educators, we are aware that this shift may be challenging in education, as science subjects are typically not considered the place to understand matters that may be considered spiritual, social or political. Similarly, with the arts, there are issues with classical views of artistic practices as being exclusive or detached from the everyday lives of people.

So, what we want to suggest is that it is important for us to consider the combination of STEM and the Arts beyond their categorization in curriculum

subjects. In this view, the ‘A’ in STEAM is more than just the Arts, to point instead to **a way of experiencing and understanding the world which is grounded in the senses**. In his work “Arts as Experience”, the philosopher John Dewey expresses this well: ““Sense” covers a wide range of contents: the sensory, the sensational, the sensitive, the sensible, and the sentimental, along with the sensuous. It includes almost everything from bare physical and emotional shock to sense itself—that is, the meaning of things present in immediate experience (p. 22).

In this vein, arts and sciences work together in STEAM not because they make a cumulative addition to a set goal, but because they target and work with the senses in different ways. In turn, awareness of how they do so, give us important insights into our own, equally different ways of sensing and being sensitised to the world. For example, **a marble statue,** although the same can be said of an iron bridge or a road**,** is a material artefact which can be studied for its chemical structure, its colour, its geographical and geological origins. But statues, bridges and roads are also forms that we can feel through their **physical presence, as material bodies located in a space that we share (Figure 1 and 2). Both modalities of sensing, through the material parts or through the perception of form involve the senses; however it is only through appreciating the different ways in which we can sense them, that we become aware of their realities, and how they are a part of ours and other people’s realities.**

Figure 1 and 2. SENSE.STEAM project @le musée du Louvre, May 2023

This has significant implications at a time when education is called upon to educate people to live together in societies that are increasingly more unequal, unstable and fractured. By moving away from a focus on disciplinary subjects and be open to phenomena in their sensorial manifestation, we can induce a shift towards attentiveness. Let's look at what this transformation from STEAM to SENSE.STEAM may look like as we explore this new educational terrain in dialogue with each other.

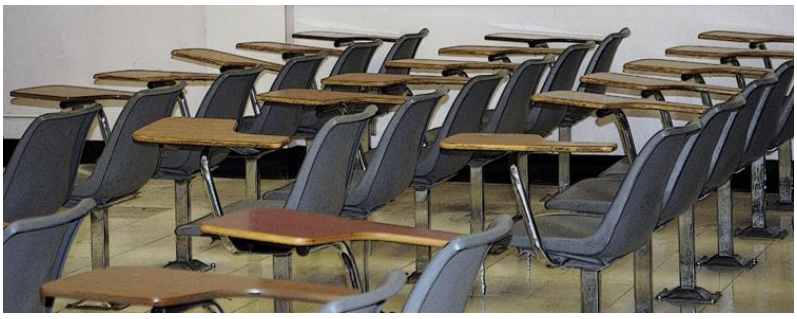
Putting STEAM education "into practice" in the real world...

What does this idea of applicability in the real world mean? And why should we as protagonists/ actors in schools, higher education or the world of work be concerned with this, is a question that often is left unanswered, if it is asked at all. As an extension of STEM, STEAM is an umbrella term, which produces different interpretations for different people. By virtue of being an acronym, it makes its way into the world, benefiting from the tacit understanding that as a new form of education its purpose is to produce prosperity, secure a comfortable future, and promote social innovation through the synergistic contributions of technology and the arts. Yet, taking a leaf from the critique offered by Arturo Escobar (2018) in his text Designs for the Pluriverse, between the futuristic and slim designs of the Silicon Valleys of the world, and the struggling communities in the Global North and Global South alike, one finds all kind of technological design and instrumentation. Similarly, one would also find all kinds of artistic practices, from those producing the new ideas that feed the neoliberal economy, to those informed by ecological awareness of planetary limits.

LAURA: Personally, as a science educator who is aware that science is not at all separate from society, understanding and addressing the relationship between economic production and ethics is one of the greatest challenges for STEAM

education. As I have written extensively elsewhere, the current conjuncture brought about by an ever more powerful technology, capable of compressing material flows across space and time, combined with an economic mindset that has decoupled freedom from justice, confronts us to re-think values and design, and collective participation in decision-making. **In this sense, STEAM may provide an opportunity to be critical but also engage us in being creators of the spaces and places in which we operate, act and communicate with each other.**

LYDIA: And to some extent, these ideas are not new. As a science educator but also as a physicist and performing artist, I am sensitised to the influential role that material objects and intentionally designed environments play in promoting, directing or hindering involvement and discourse. The imagery of traditional classrooms, characterised by orderly rows of desks and an authoritative teacher at the front, bears a striking resemblance to workbench setups found in laboratories and the utilitarian design of car parks or supermarket shelves (Figures 3 and 4). These spaces prioritise functionality and offer limited scope for movement, interaction or choice.



Figures 3 and 4. Car parks and school classrooms

In fact, this brings me to think how much of these spatial arrangements have literally been ‘hacked’ by young people through the power of the physical and performing arts. Hip-hop culture, parkour and street dance speak of very different understandings of space, far beyond the idea of a container, but more as complex landscapes in which physical skills, minds and dreams come together. The hip-hop dancer Breis for example talks about knowledge of self, “as being able to understand who we are and how we operate in this world”. Space in this case is the public space, serving the logic of communication, of coming into contact with one’s and other peoples’ experiences and realities.

LAURA: Also in the visual arts, hacking is a way to bring back sovereignty in the digital space. Many examples exist with emerging collectives of activists, artists, educators and researchers seeking to upturn the politics of neoliberal, digital spaces against perpetual deskilling and fragmentation. The Pirate Care syllabus for example comprises a series of freely accessible resources from housing needs to debt to support communities to harness legal, economics and political resources that are often the exclusive privilege of professional classes. And the DECODE project brings together hacktivists and the municipalities of Barcelona and Amsterdam to create shared digital tools that put individuals in control of whether they keep their personal data private or share it for the public good.

These examples to our mind speak clearly of the possibilities and potential **for another STEAM education. One that brings sense experience and human experience to the fore**. Yet, we are both aware that many educational institutions push back.

Shifting from this model to a new configuration that accounts for the possibility of plurality seriously, points to a still unresolved issue in the ways we think of ourselves as humans, as beings in the world, but not of it. Therefore, to return to our original question, this emphasis on STEAM education in the real world should call upon our efforts not to create another world, that is somewhere else for somebody else; a world that stands in the way of the old and presents itself as the salvation anew. This is the promise of the market economy: to discard what went before with the creation of new needs, real or imagined, demanding new consumption for their fulfilment.

In order to move towards this idea of STEAM education as embedded in the real world, what is present to others and to ourselves, we need to draw out some other dimensions of STEAM. This would involve a rethinking of sciences and arts not as a means to pre-determined ends, but as practices of inquiry and sense-making which have accompanied the experience of humans' communities since their very first appearance on this Earth.

… and attentiveness as sensing-with and making-sense with others

This takes us to the second point we introduced at the start of this article, which is Attentiveness. Attentiveness as the ability to pay attention to something, someone or somewhere, is situated within the sensing body, as a nexus of cognition and emotion, affection and action. In being attentive, we are interested and curious about what is going on around us, but also about what is going on inside us - how we respond and orient ourselves towards the other. Yet this capacity is far from being a natural or efficient occurrence in everyday life. Paying attention requires us to reflect and acknowledge how we direct our focus. It requires practicing the skill of attention as we cannot take it for granted, considering our habits and routines as socially adapted, urban individuals. These behaviours often guide us towards set goals or tasks. As such, how does STEAM develop attentiveness and a model of education that encourages a collective conscience?

The words experience and experiment share a common root, from the Latin word **experīrier**, which points in the first instance to the process of going through, to attempt, to endure. Differently from the controlled image of the modernistic science lab, the experimentation that comes with the process of knowing is far from a neutral or detached affair. Rather, to gain experience via experimentation involves tempering oneself, contending with the dangers of experience, from which we gain knowledge but also memories, affective associations and sensory impressions that are triggered, modulated and retained within us, in our own human, sensing bodies. Hence in this going through there is also an undergoing, meaning that we are not simply experimenting on something 'out there', but in the process of understanding and changing the world, we also understand and change ourselves. **With the word experimentation in SENSE.STEAM, we thus wish to bring into focus the**

possibility to draw upon science and the arts as practices of inquiry disclosing the wider array of capacities to become acquainted with our own human experiences. By searching for a pluralist and equitable approach to the real world, then we are not searching for a model of education hell bent on reducing variability amongst subjects, but one, which nurtures it.

LAURA: As a natural scientist and educator, I see one way of approaching this question might be to explore more deeply what it means to be curious, not as a way of extracting something from somewhere else, or as the act of standing apart and looking at some truth, but as the capacity to continuously attend to what is before - or inside us - following its changes and manifestations. I see this capacity to attend as being closely linked to curiosity because the intention is not to analyse or to judge, but to allow something to continue and to evolve along its course. This is also where the experience lies. Because curiosity involves the ability to shift one's own way of looking and to remain open to the process as it unfolds. Far from being an intellectual or cognitive endeavour, it involves the ability to attend to the other by imagining what is like from their points of view and how they may be influenced by their being in relation with us.

LYDIA: This resonates with me also as a physicist, educator and artist**.** Openness to me is this receptive disposition that enables us to perceive the world not merely as a predetermined entity, but as a dynamic tapestry of evolving ideas and perspectives, thereby fostering a genuine and enduring curiosity that transcends mere intellectual inquiry. Yet we need to acknowledge that the world of science education, at least in schools, is still very much dominated by a Newtonian worldview. In this world, things are perceived as constant, and their characteristics are considered absolute and unchanging. They are viewed as independent from those observing them and are not affected by their surroundings or altered in nature upon interacting with the environment. Accordingly, the approach to understanding the world favoured by western science is rooted into a form of reductionism in which aspects of the world are modelled into systems, and these systems can be understood based on their constituent parts, their properties and a limited number of causal interactions. In addition, as other researchers have said for some time now, science education still tends to be locked into a post-war mentality concerned with how to control and rule this world4. The development of machineries or weapons appears somehow more

‘scientific’ than caring for the impact this may have on other people, other creatures and their places.

Therefore, in the more conventional sense, the STEAM acronym points to disciplinary subjects and expertise providing descriptions of the world; but in the relational and reciprocal sense, what we are researching in this project is in fact a greater and more nuanced attention to the salience of concrete and localised problems, events or phenomena.

For example, being called upon the observation of a spider web on a sunny and misty morning brings a rarely noticed phenomenon to one’s attention, and here they are, webs scattered everywhere, crocheted upon bushes and amongst the branches. The spider web becomes salient to us, and in this becoming salient, the act of education becomes political, making visible the invisible, forging a new cartography of the sensible and the perceptible, but also the thinkable and the feasible5.

In SENSE.STEAM then, attentiveness is intimately linked to aesthetic perception, which is the domain not only of the arts but also of the sciences, since aesthetics becomes the vehicle through which we are able to perceive, feel and to feel with. Works of art and scientific protocols are thus not merely sensorial triggers for individual pleasure, or tools for detecting information from the realm of the sensible, but they are recognised as processes, as individual and cultural practices that frame and stage our sensorial experiences, helping us to perceive and interact in different ways. In this modality, arts and sciences can make the realities of others salient to us, helping us construct different spatial and temporal configurations, as well as different forms of common sense.

The Finnish architect Julian Pallasmaa passionately argued about this in his critique of contemporary architecture and the loss of our ability to imagine alternative worlds. Speaking against the instrumentalization of contemporary architecture, he arrives at a significant design and ethical conclusion: “A building is not an end in itself. A building conditions and transforms the human experience of reality”. “It frames, structures, articulates, links, separates and unites, enables and prohibits”6 (p.96). This is because a building acts as a framing device, with the ability to direct and shape our capacity to tend and to attend to, as we interact with its material structures with our entire body and senses.

The quest for SENSE.STEAM education is therefore open; and it is driven not by an economic imperative but a holistic and transformative one; an imperative that brings to the centre the question of attention but above all that of relations:

- how far can we re-imagine our aesthetic and knowledge practices in ways that keep the other in view?
- In what way can we practice with perceptual devices to target aesthetics, work with it and make it a problem?
- Finally, how do we move from seeing to 'seeing differently', keeping the process of attentiveness open and ongoing?

In our SENSE.STEAM project we are creating and evaluating practices, that by their definition are not simply activities for doing STEAM; or STEAM activities to deliver concept more effectively. What we propose is to **join in the experimentation:** to practice the practice of attentiveness; to work with artistic and scientific devices and to challenge their focus, their time frames, their locations and to produce new questions, bringing the experiences of humans and more then human others into focus.

Variations on looking at a photo

Here is a little activity (Laura). I took these two pictures (Figures 5 and 6) during our visit to Georgia on 5th October 2023, hosted by Women for a Common Future. Look at them, what do you see? What becomes important to you? Is this how you would have thought of the place when you first read the name of the location? In what way is the appearance of these pictures making you curious?

They do make me curious, indeed. (Lydia). And I wonder - could this be anywhere else in the world? What's outside the frame? What did the place sound like where these pictures were taken? Who collected the items in the image to the left? And, by the way, who took the pictures?

Figures 5 and 6. Touching, sounding and feeling the image

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