



creative classrooms for the AI age

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abstract

This white paper examines the evolving educational landscape in the age of artificial intelligence (AI) through the lens of creativity, as proposed by Margaret Boden's three modalities: combinational, exploratory, and transformational creativity.

Within the context of traditional factory-style education, we recognise the pressing need for a paradigm shift in our approach to education and the design of learning spaces. The transformative impact of AI demands a reevaluation of our educational methods, with a strong emphasis on fostering creativity.

By drawing inspiration from visionaries such as Herman Hertzberger, Oscar Niemeyer, Zaha Hadid, Bernard Tschumi, and Nana Ditzel, we chart a path towards the reimagining of educational spaces that nurture the three facets of creativity outlined by Boden. Through an exploration of case studies, including the Plymouth School of Creative Arts, the Maya Somaiya Library, and the Imagine Montessori School, this white paper provides tangible examples of these strategies in action within contemporary educational architecture.

introduction

In an epoch defined by the ascent of artificial intelligence (AI), we find ourselves engrossed in discussions concerning the challenges and prospects of AI. The swift progress of AI has led to apprehensions about job obsolescence, diversity and inclusivity, privacy issues, and the potential misuse of AI by rogue actors. As we grapple with these issues, we can turn to history for insights and examine how prior technological revolutions reshaped societies, generating both threats and opportunities.

Looking back to the end of the nineteenth century, we find a similar period of significant technological upheaval. The final two decades of the century witnessed the invention of the recoil operated machine gun, the Parsons

steam turbine, coated photographic paper, the Tesla electric motor, the Kodak box camera, the automobile, Dunlop's pneumatic tyre, cordite, the diesel engine, the cinematograph, the gramophone disc, the invention of X-Rays, radium, radiotelegraphy, voice radio transmissions, the movie camera and the principle of rocket drive.



Nikola Tesla's experiments

The fears that accompanied these technological leaps in the early 20th century bear a striking resemblance to those we confront in the face of AI today. There was an overarching fear of mortality, as illustrated by the destructive potential of new weaponry. There was also the dread of obsolescence, as traditional craftsmanship and artistic forms confronted radical changes. In the midst of this radical of change, we can look at the realm of sculpture to see how creative minds responded to the challenges of their time and found avenues for relevance and optimism.

In a world where sculptors were traditionally tethered to materials like stone and bronze, their craft rooted in realistic representation, the emergence of technologies such as photography and film posed a formidable threat. Innovators like Eadweard Muybridge and Étienne-Jules Marey harnessed photography to superimpose multiple frames in a single image, a precursor to modern animation. The Lumière brothers pioneered motion pictures, with their iconic film of a train's arrival at a station.



The first public sculpture to the motor car, Camille Lefebvre

Traditional static and austere sculptures, like the first public sculpture dedicated to the motor car, stood in stark contrast to the dynamic and evolving world they sought to depict. Artists employing traditional methods must have sensed that their approaches were at risk of obsolescence. It was a period of creative reckoning as artists grappled with the question: how could they remain relevant?

Nevertheless, an avant-garde of creative minds perceived the potential of these technological innovations. Artists like the Italian Futurist Umberto Boccioni embraced the spirit of the age, capturing its dynamism and energy in their work. Boccioni's sculpture, 'Unique Forms of Continuity in Space,' stands as a testament to this creative awakening. With its remarkably aerodynamic and abstract design, it transcends the constraints of traditional sculpture, offering a dynamic and almost kinetic representation of movement.

Boccioni's work serves as a potent reminder of the resilience and adaptability of the human creative spirit in the face of technological upheaval. Just as artists in the early 20th century discovered new avenues to remain relevant and optimistic by harnessing the possibilities of their time, we must draw inspiration from their legacy as we confront the challenges and opportunities presented by AI in the 21st century.

In these challenging times, it is the spirit of creativity and innovation that must illuminate our path forward, just as it did for the Futurists.

We need a new generation of creative thinkers who can envision novel ways to adapt and thrive in a world where AI is an integral part of our daily lives. As we stand on the threshold of an AI-driven future, we should draw inspiration from history and recognise that human creativity has consistently been the driving force that transforms challenges into opportunities.



Unique Forms of Continuity in Space, Umberto Boccioni

process/method

The era of AI is upon us, and a fundamental question remains: will we passively submit to it, or will we actively shape it? This white paper embarks on an exploration of how we can place creativity at the core of the education of the future, and, in particular, how we can utilise the 'third teacher,' the learning environment, to nurture creativity.

Divided into three sections, this white paper delves into three modalities of creativity as defined by Margaret Boden: combinational, exploratory, and transformational creativity. Each section explores the operation of these modalities and examines the work of influential architects and designers who have

demonstrated how each can be fostered within the built environment. A case study illustrating these strategies at work in a recent educational building is also scrutinised. From these examples, we derive implications for future practice.

outcome/findings

combinational creativity

Combinational creativity, as described by Boden, entails the art of merging familiar ideas in fresh and unconventional ways. This process, a fusion of concepts, paves the way for novel associations to take shape. Boden takes collage to exemplify this facet of creativity. Consider Richard Hamilton's artwork, *Just what was it that made yesterday's homes so different, so appealing?* Here, common images



Just what was it that made yesterday's homes so different, so appealing? Richard Hamilton

merge unexpectedly within a domestic setting: a Jackson Pollock painting transforms into a rug, the ceiling is a photograph of the moon, and modern appliances share the space with a bodybuilder protagonist holding a wrapped candy. What transpires are a series of fresh connections, weaving together the era's science, art, sexual ethics, and consumerism.

key thinker — Herman Hertzberger

In the architecture of Herman Hertzberger, we discern the embodiment of this combinational creativity driven by the creation of social spaces. In social spaces individuals encounter one another, with each perspective and interaction offering the potential for new associations to develop.

Hertzberger, born in 1932, masters communal spaces in his work, including a diverse array of educational projects. His approach involves a transformation of the circulatory space within his architectural designs into an experience reminiscent of a busy street. He steers clear of the conventional corridor, where circulation is a separate 'space' within the building. Instead, he integrates it into the fabric of the community, much like a city street. Hertzberger's circulation is unrestrained, opening onto soaring atria that span the building's full height. This allows you to witness all the building's occupants simultaneously, with no divisions imposed by floor plates. Hertzberger astutely observes, "corridors were invented because architects put their rooms together in a non-urbanist way." As soon as one adopts an urbanistic perspective on building design, streets replace corridors.



Faculty of Science, Utrecht University, Hertzberger

Nonetheless, Hertzberger's ambition extends beyond merely fostering a sense of community. He strives to replicate the essence of a street. In his analysis, this experience possesses a unique appeal. Hertzberger attributes the charm of streets to the quality of natural light, the abundant sunlight from above. This is a characteristic he consistently incorporates into his circulatory routes, which open onto atria, bathed in natural light, with rooflights revealing the sky.

A central concept in Hertzberger's design philosophy is 'incentivisation.' He places features in the building that invite user interaction. Hertzberger comprehends that these cues encourage people to pause and engage, fostering opportunities for socialisation or even sparking conversations. Drawing inspiration from the street once more, he introduces such 'incentives,' like the columns at the Apollo Schools. These columns offer a space to rest and socialise, inspired by Bernini's colonnade at St. Peter's Basilica. Other urban settings that have influenced Hertzberger include the steps

at Columbia University and the Rockefeller Plaza. In the latter case, Hertzberger identifies a compelling fusion of protection and openness. He asserts the importance of balancing these qualities within a space, arguing that an environment that is overly open can be unwelcoming. Such a duality can be seen in the handling of communal areas in his Waterrijk Neighbourhood Centre.



(top) Rockefeller Plaza
(bottom) Waterrijk Neighbourhood Centre, Hertzberger



(top) The colonnade at St. Peter's Basilica, Bernini
(bottom) Apollo Schools, Hertzberger

implications for future practice:

- Replace traditional corridors with circulation spaces that open onto expansive atria.
- Integrate 'incentives' that provide places for people to pause or initiate discussions.
- Ensure that open spaces are filled with natural light, and incorporate elements of enclosure.

case study – Plymouth School of Creative Arts

The Plymouth School of Creative Arts by Feilden Clegg Bradley Studios, stands as a cornerstone in this white paper, embodying the core principles of creativity. It offers insights that resonate with the philosophies of both Boden and Hertzberger. At this school, creativity is not confined to a set of subjects or the confines of ‘the arts’ within a STEAM curriculum. Instead, it is viewed as a pervasive intelligence applicable across the entire educational spectrum. As Andy Theobald, partner at Feilden Clegg Bradley Studios, who oversaw the project, aptly puts it, “there is no art room because art is everywhere.” Embracing this philosophy, the pedagogy recognises that creativity thrives through social interaction, giving rise to the combinational modality where novel associations emerge. Teachers are actively encouraged to share their methods and insights, and students are urged to engage beyond their usual peer groups.



*The Plymouth School of Creative Arts,
Feilden Clegg Bradley Studios*

The architectural design of the school plays a pivotal role in nurturing this collaborative behaviour, a transformation heralded as groundbreaking in the realm of secondary education in England. To create the necessary social space, Feilden Clegg Bradley Studios employs an approach that shares its architectural DNA with the principles championed by Hertzberger. Much like the Dutch architect’s work, traditional corridors are replaced with open circulation spaces surrounding expansive atria, filled with natural light. Transparent internal

partitions open vistas within the building, fostering a sense of community.

implications for future practice:

- Innovate ways to infuse creativity into all learning spaces, extending beyond those conventionally designated for ‘the arts.’
- Utilise transparent partitions to create a visual and social interconnectedness between internal spaces.

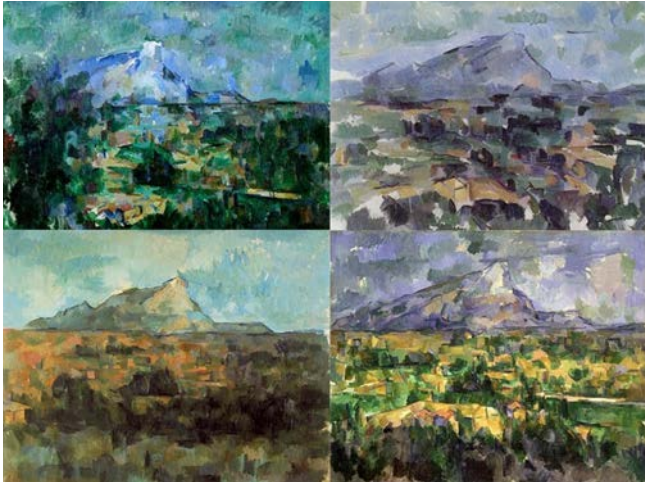


Open circulation spaces and expansive atria

exploratory creativity:

Exploratory creativity, as described by Boden, involves the exploration of accepted styles of thinking. This concept can be likened to the artistic technique of theme and variation, much like Cezanne’s approach to Mont Saint-Victoire. Cezanne would frequently revisit this subject, and the compositions, while unique, share his signature style, characterized by a mesh of lozenge-like brushstrokes. Boden’s notion of exploratory creativity entails taking a conceptual space and ‘moving around in it,’ visiting uncharted territories that have always existed as potential within that space. Boden’s linking exploratory creativity with ‘moving around’ is a crucial insight. It’s worth noting that movement, in general, is a potent stimulator of mental activity, but it becomes especially effective in driving exploratory creativity.

A study conducted by Marilyn Oppezzo, a Stanford behavioral and educational scientist,

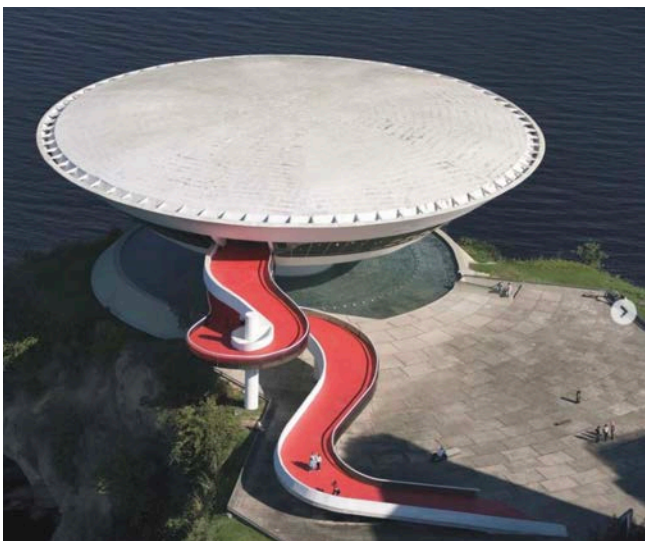


Various paintings of Mont Saint-Victoire, Cezanne

revealed the impact of movement on exploratory thinking. Participants were asked to brainstorm as many possible uses for a common object, a key, within a four-minute time frame. The results were illuminating – those who were walking during the task generated twice as many ideas as those who were sitting. This study underscores the link between physical movement and cognitive exploration, where a conceptual field, uses for a key, is pushed into uncharted territory. The architectural strategy to encourage this second of Boden’s modalities is clear: an architecture where users are active.

key thinkers – Oscar Niemeyer and Zaha Hadid

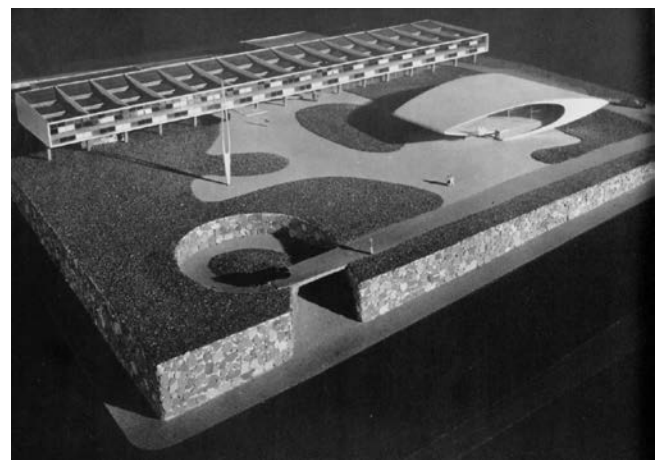
In our exploration of such an architecture, two key visionaries come to the forefront: Oscar Niemeyer and Zaha Hadid, recipients of the Pritzker Architecture Prize in 1988 and 2004,



The ramp at Niterói Contemporary Art Museum, Niemeyer

respectively. Niemeyer left a lasting legacy, particularly in Brazil, where he realised some of his most remarkable creations. Key to our debate is his virtuoso handling of movement. Norman Foster, recalling the twisting ramp of his Niterói Contemporary Art Museum in Rio de Janeiro, describes it as a dance: an evocative route that curls and loops back on itself, offering different perspectives back on the building. The journey has an intrinsic significance, with qualities of joy and delight. This is characteristic of Niemeyer, who offers opportunities for movement for their own sake.

Niemeyer’s approach to educational architecture, exemplified by the Milton Campos school, is equally choreographed. As with the Niterói gallery, access to the school is by means of a ramp, which leads to a meandering path. Students engage in further ramps to access the auditorium or the main school space. The use of the campus, rather than a consolidated building, is key in creating opportunities for movement.



Model of Milton Campos, Niemeyer

Zaha Hadid, a longtime admirer of Niemeyer, carried on the tradition of celebrating movement in her architectural designs. In her work, like the MAXXI Art Gallery in Rome, her circulatory space becomes the dominant facet of the user’s experience. In the large atria of the MAXXI no art is on show. The primary function of the building has become obscured by the spectacle of the seemingly free-floating staircases and walkways. Although this might be levelled as a criticism, in the context of



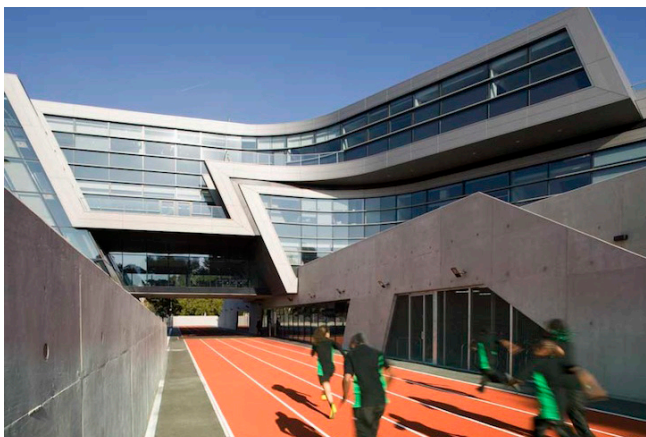
MAXXI, Hadid

this conversation it shows an architecture where movement becomes the central theme, stimulating exploration.

Like Niemeyer, Hadid carries this lesson through to her educational projects, like the Evelyn Grace School in London, which won the Stirling Prize in 2011. In this project, sinuous corridors link the classrooms, and the running track dating under the twisting mass of the school is a manifesto for embedding movement at the heart of educational architecture.

Implications for future practice:

- Focus on creating rich and textured routes through a building, rather than focussing on the efficiency of the movement strategy.



Evelyn Grace Academy, Hadid

- Consider how splitting a campus into multiple buildings could offer opportunities to keep students moving.

case study – Maya Somaiya Library

The Maya Somaiya Library, designed by Sameep Padora + Associates (sP+a) for the Shri Sharda School in India, serves as a remarkable case study. This project challenges the conventional notion of libraries as static. Libraries are excellent spaces for exploratory creativity. If we return to Boden's definition, what the creative mind explores in this modality are "accepted styles of thinking", with libraries offering these in abundance. However, an understanding of a link between movement and exploratory thinking is often missing in spaces designed for sedentary working and reflection.



The walkable roof of the Maya Somaiya Library, sP+a

sP+a challenge that with a library that emphasises movement in its spectacular centrepiece: a walkable roof. A Catalan vault with remarkable compressive strength, the roof can bear the weight of students traversing it. This rooftop journey is devoid of any goals or waypoints, understanding, much like the work of Niemeyer and Hadid, that the act of movement is intrinsically valuable. With its undulating topography, the delightful rise and fall of the roof's topography encourages students towards movement and creative exploration as part of their learning experience.

implications for future practice:

- Consider how the whole building can become an opportunity for movement, beyond what's typically identified as circulation space.

transformational creativity

Examining the final of Boden's three modalities takes us to the domain of transformational creativity. As Boden describes it, this form of creativity is about "not doing what's been done before." It's the most astonishing aspect of creative expression, capable of birthing revolutionary ideas. In the world of art, a prime example is pointillism. This movement, in works like *Sunday on La Grande Jette* by Seurat challenged the established norms of painting. Instead of linear brush strokes and blended colours, Pointillists rewrote the entire methodology by using pure dots of hue to construct images. How do we design for transformational creativity? This is where the narrative takes an intriguing turn, for we aim to encourage users of a building to venture into uncharted territory, to think of new ways to utilise a space: to enter into the mindset of transformational creativity.



Sunday on La Grande Jette, Seurat

The first essential element in this endeavour is the introduction of ambiguity of use. However, a unique challenge surfaces when considering spaces like a sports hall. While such spaces can serve various purposes, they often retain a distinct identity. Even when empty, they exude a strong inclination toward their primary function. How do we push these boundaries further?

key visionaries — Bernard Tschumi and Nana Ditzel

Our first thinker is Bernard Tschumi, a Swiss architect renowned for his theoretical designs

and association with Jacques Derrida. Tschumi's most iconic project, "Le Case Vide" is a public park located in the northwest of Paris. His vision involved a series of pavilions dispersed throughout the park. Tschumi's objective was to create an ensemble devoid of predetermined uses and open to limitless possibilities and change. His first strategy was to create spaces that have an ambiguity of use. In this, his efforts were a success. One pavilion, originally designed as a kindergarten, transformed into a television studio. Another pavilion, intended as a plant nursery, is now a sculpture studio.



Folie J5 at Le Case Vide, Tschumi

However, Tschumi takes the step beyond ambiguity of use with a key insight. He recognises that to truly provoke novel thinking about space, a building must be unexpected. If ambiguity of use is often answered by our pre-conceptions about its use, Tschumi's pavilions are unconventional and thought-provoking, often bordering on sculpture, adorned with peculiar appendages like spiral staircases or water wheels.

The idea that unexpected form-making encourages transformational creativity is something Tschumi has directly appreciated. Describing his pavilion for an outdoor exhibition at Groningen, now known as the Tschumi Pavilion, he notes how "it is used in ways which we never could have foreseen before". He adds, "the fact that the building is slightly twisted and slightly turned forces a reinvention every time of what the building is." As a space to foster creativity, it has been notably successful,

despite a design that might appear decidedly impractical in its flouting of architectural norms. Indeed, the pavilion has outlasted other structures by Zaha Hadid, Peter Eisenman, and Co-op Himmelblau constructed for the same event.



The Tschumi Pavilion, Tschumi

Our second visionary thinker, Nana Ditzel, had a similar approach in her work as a furniture designer. Ditzel’s innovative installations exploit all three dimensions of a room, creating landscapes which offer users a range of different ways to engage with them, by sitting or lying, either across one level, or by taking advantage of their stepping form. These designs go beyond merely creating an ambiguity of use, however, and their novelty flies in the face of the expected. They challenge even the basic categories we use to interpret our environment, like floor and furniture, chair and table. Before Tschumi, Ditzel had realised the power of the unexpected to inspire transformational creativity. Recalling her mother’s ambition, Dennie Ditzel described how “she was sure that those who sat in these arrangements would think differently”. More than just an exercise in novelty, “she wanted us all to enjoy a setting where it was possible to be free and creative.”



The Padded Cell, Ditzel

Ditzel’s profound realisation was that to encourage people to utilise space in new ways we need to move them from a mindset of how a space ‘should’ be used, to think instead about how it ‘could’ be used: here the realm of play is key. The playful becomes a key quality in Ditzel’s work. In the example of her Toadstall stool, it is unclear which way is up or down. As the child reflects on how to position the stool a third option comes to mind: what if I place it on its side? On its side, the toad-stall rolls, and can become a game. The novelty and enjoyment of this potential encourages a child to invent a new way to interact with the stool every day. In doing so, they enter Boden’s third modality of creativity: the transformational.



Toadstall Stool, Ditzel

implications for future practice

- Create ambiguity of use, to create spaces which can be reinterpreted by students.
- Use unexpected forms and depart from architectural conventions to inspire the user to approach spaces in novel ways.
- Find opportunities to encourage play in learning spaces.

case study – Imagine Montessori School by Gradolí & Sanz

Our contemporary case study, Imagine Montessori School by Gradolí & Sanz, embodies the spirit of transformational creativity. Unlike conventional architectural approaches that seek to tightly control the use of every space, this project in Valencia, Spain, adopts a refreshing perspective. It treats unexpected uses as a measure of the project’s success.



Imagine Montessori School, Gradolí & Sanz

The architects, in interviews, celebrate the way students co-opted an open area underneath a staircase as ‘the cave’. They also delight at students conversion of a column into a climbing wall. The goal is clear: for people to utilise spaces in unconventional and imaginative ways.

This approach challenges established architectural approaches. Instead of meticulously programming the architecture, it allows the freedom of play to naturally find its place. It shifts the user’s experience from passive to active, and opens space to a transformative mindset.

implications for future practice

- Instead of programming spaces, create architecture that has the contingency for adaptive use and an open-endedness.
- See users as co-creators of space and celebrate their participation in the architecture.



The improvised climbing wall at Imagine Montessori School, Gradolí & Sanz

conclusion

We continue to operate within an educational framework reminiscent of factory-style learning, a structure that is mirrored in our physical learning environments. Despite the best efforts of progressive educators, architects, and policymakers, the predominant model of teaching places students in nearly identical classrooms, a paradigm that has endured for centuries. It seems that we have yet to break free from this entrenched pattern of education.

In this discussion, we draw inspiration from the insights of mathematician Marcus du Sautoy, who offers a fresh and compelling perspective. In the backdrop of an AI-driven era filled with its own set of challenges and anxieties, du Sautoy presents an intriguing concept: the potential for us to rediscover and enhance our profound humanity. The journey we have embarked upon aligns with this vision.

As AI continues its relentless evolution, it forces us to reevaluate our educational approach and the design of learning spaces. It compels us to champion creativity as a central tenet, offering a response to the demands of a rapidly changing technological landscape. In embracing this shift, we lay the groundwork for an architectural renaissance that prioritizes social interaction, movement, and boundless possibility over the rigidity of the status quo. This white paper aspires to awaken the intrinsic creativity that defines our humanity and holds the key to navigating the challenges and opportunities presented by the AI age.

references

Bech Dyg, Kasper, ed. 2018. "Nanna Ditzel Design an Image of Life." Louisiana Museum of Modern Art. <https://channel.louisiana.dk/video/nanna-ditzel-design-an-image-of-life>.

Boden, Margaret A. 2010. *Creativity and Art: Three Roads to Surprise*. Oxford: Oxford University Press.

Gómez-Moriana, Rafael. 2021. "Hide and Seek: Imagine Montessori Primary School in Valencia, Spain by Gradolí & Sanz - Architectural Review." *Architectural Review*. May 10, 2021. <https://www.architectural-review.com/buildings/school/hide-and-see-Imagine-montessori-primary-school-in-valencia-spain-by-gradoli-sanz>.

Hertzberger, Herman. 2016. *Lessons for Students in Architecture*. Rotterdam: NAI Publishers.

Hughes, Clare. 2017. "The Red House." FCBStudios. <https://fcbstudios.com/practice/explore/the-red-house/>.

Jodidio, Philip. 2013. *Hadid: Zaha Hadid Complete Works, 1979-Today*. Köln: Taschen.

McCarter, Robert. 2015. *Herman Hertzberger*. Rotterdam: NAI Publishers.

Papadaki, Stamo. 1956. *Oscar Niemeyer: Works in Progress*. New York: Reinhold.

Robert Hughes. 1991. *The Shock of the New: Art and the Century of Change*. London: Thames and Hudson.

Sautoy, Marcus du. 2019. *The Creativity Code: How AI Is Learning to Write, Paint and Think*. London: 4th Estate.

Srivathsan, A. 2018. "All in the Mound: Maya Somaiya Library in Kopergaon, India, by Sameep Padora + Associates." *Architectural Review*. December 18, 2018. <https://www.architectural-review.com/buildings/all-in-the-mound-maya-somaiya-library-in-kopergaon-india-by-sameep-padora-associates>.

Tschumi, Bernard. 1985. *La Case Vide, (La Villette 1985)*. London: Architectural Association.

Tschumi, Bernard. 2016. "Bernard Tschumi." *A+ Architecture in Belgium*. <https://a-plus.be/fr/conference/bernard-tschumi/>.