LISTAHÁSKÓLI ÍSLANDS
Iceland Academy of the Arts

Department of Design and Architecture
Master of Design

Bio/Geo-mimetric Mentoring tool

Creating an empowering Geometric-mentoring tool,
achieving cross-disciplinary knowledge through mimicing nature.

Sinéad McCarron

A document submitted to: The Department of Design and Architecture, Iceland Academy of the Arts, in partial fulfillment of the requirements for the degree of Master of Design, 2016.

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Abstract

The purpose of the research is to discover the possibility of creating a mentoring tool, which empowers the learner, and moves away from labeling learner's inabilities and barriers. A tool that will see the learner thrive and move away from a survival state in traditional learning environments. Shifting away from ''teacher and student' to 'mentor and learner' relationships through co-creative techniques.
Combining academic disciplines in problem solving, discoveries and experiences encouraging curiosity, away from the classroom and towards the natural world. Empowering learners to be bold, critical and curious in their endeavours. Being mindful to question their position as co-inhabitants of the world whilst being intuitive to imagination and fantasy. Inspire learners to discover nature through geometric shapes and process these discoveries into tactile outcomes, possibly learning mathematical/logical patterns, scientific discoveries and even inventing their own Music, Art, Design and outcomes. Looking at future technologies such as virtual worlds and 3D printing. Being practical, creative and analytical of their outcomes. Whilst using Pi, Phi and Fibonacci as a metaphor for mapping their growth and a process of 'becoming'.

Highlighting the importance of 'ownership' of the learner's journey and discoveries is the property of the learner. Whilst attaching the importance of mentor and learner relationship.

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1. Introduction

We can see in both the developed world and the developing world that formal education is in trouble and with this we are seeing educators looking at meaningful alternatives. Classrooms are currently narrated, mechanical and routine based, expecting students to memorise through teaching. Preparing learners for a structured society heavily controlled by economic forces after the completion of education. The characteristics of the learner are being constrained through limitations of labeling the learner, by disability, sexual orientation, ethnicity, culture diversity and economic class. We even see the most able learners stigmatized, becoming restless finding themselves in a survival state. IQ test and exams being repeated all over the world a thousand times everyday which inflicts anxiety and fear on the learner thinking one´s ability in these test will reflect on eligibility for future hopes and dreams in the working market. Finally subject based learning which is ranked in hierarchy of importance and focused on one subject at a time which is limiting the integration of knowledge within different subject areas, as well as placing humanities subject into minor roles. As well as the natural and built environment; support and relationships, and systems we are seeing tools & products placing restrictions and limitations on the learner. Pedagogical tools that are subject based learning are being provided and focusing a lot on 'inabilities' such as dyslexia, ADHD and more which is isolating and enabling more constraints and anxiety on these learners. Mirroring our current educational systems. Can we create mentoring tools rather than a pedagogical tool that is learner focused and is empowering as opposed to a tool that advocates social inequality and inabilities? An experience that shifts learning from instruction to discovery. Curiosity based mentoring tools that allows for exploration and advocates cross-disciplinary learning through personal interests. Empowering the learner through personal potential and 'ownership' of their personal achievements and journey of exploration. Aristotle said that "educating the mind without educating the heart is no education at all."[1] Possibly connecting the learner's to the community, nature, and the universe and also to the humanitarian values of their surrounding environments, whilst connecting with their identity meaning and purpose in life.

Can a tool allow the scrapping of the traditional format of learning that sees rows of pupils sitting disinterested and passive in front of their teacher? Seemingly listening to lessons, impatient and waiting to be questioned? I aim to model a tool that will take self-directed collaborative approaches on problem solving across disciplines. Thus resulting in a more active and attentive learner.

Most education is fueled by awards, but what if learners are to focus on the pursuit and not the end result? Being aware of your whole self, and embracing your mistakes as a process of learning. The learner should be unrestricted and move away from mechanical memorization and learning of content. Liberated of genetic, cultural, or class determination. Free to be adventurous, motivated by curiosity and dream differently. Use their own individual experience in life and take the journey to proclaim ownership of their own discoveries.

In my approach I will touch upon moving away from dehumanizing approaches of society through our education systems. I will be exploring a model where the learners see themselves as thriving instead of surviving in their learning and society as a whole. Looking at teacher-student relationships where respect must be reflective. Mentors will need to be ethical in their approaches and encourage learners to take things step by step. Mentors will encourage learners in the process of 'becoming' and how learning is life durational and part of growth. Mentors themselves will not behave as they are the owners of the knowledge and truth, they in turn must be open-minded to learning from their students. Creating compassionate learners to our built environments and experiences. Bridging a gap between our passions/ hearts, our abilities and experiences allowing for critical thinking and investigation. Creating mindful learners rather than mind full.

1 Aristotle. *The Nicomachean Ethics N/e.* Edited by Lesley Brown. Translated by David Ross.

2. Who and Why?

Learners are seeing school settings as a means of survival rather than a journey of self-exploration and discovery. Teachers too are finding themselves searching for alternatives through new school reforms such as Waldorf education, holistic education, problem based learning and one of the newer reforms phenomenon-based learning to name a few.

In today's pedagogical system it is very much still narrated and mechanical based development. Where the ruling classes are viewed as the thinkers and producers of ideas. A manufacturing capitalist approach to learning modeled a Marxist view of education. "This capitalist economic form imposes "strict limits" on the normal reach of men's consciousness, on-specifically-their capacity to apprehend the "contradictions" and irrationalities of the obtaining social formation."[2]

Paulo Freire talks about how we need to shift from this capitalist approach which he calls the 'banking concept' of dehumanizing the learner to introduce critical pedagogy teaching to understand political and economic forces that influences the structure of society in order to prepare them to work for social change. Like Freire I myself yearned to break away from British colonialism in our education system in an Irish catholic background in Northern Ireland, which I felt constrained my freedom.

> This solution is not (nor can it be) found in the 'banking concept'. On the contrary, banking education maintains and even stimulates the contradiction through the following attitudes and practices, which mirror oppressive society: such as the teacher teaches and the students are taught.[3]

"Oppression – overwhelming control – is necrophilic; it is nourished by love of death, not life. The banking concept of education, which serves the interests of oppression, is also necrophilic."[4]

The culture of the 'the banking system' is itself constraining which poses a problem worldwide proving projective blocks (or "limitations") via labeling. Labels such as socio-economic status, race, ethnicity, gender, disabilities etc where the marginalization societies and the elite both do suffer this fear of freedom and "constrains the fearful and subdued, the "rejects of life," to extend their trembling hands."[5]

2 John McMurtry, ***Structure of Marx's World-View.*** Pg 43
3 Paulo Freire, and Donaldo P. Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, Pg72
4 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, Pg77
5 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 1, Pg45

Freire speaks of moving on from this narrative education with the teacher as the narrator and the students as "containers"[6] to be filled by the teacher and suggests critical pedagogy using problem posing (solving) as a way to link education to the lives of the students by reconciling the poles of the contradiction so that both are simultaneously teachers and students. "The students – no longer docile listeners – are now critical co-investigators_ in dialogue with the teacher."[8] We must move on from the current pedagogical system where the teacher determines what, how and when anything is learned and inflicting this anxiety and oppression on the learner. To "problem-posing education which affirms the learner as beings in the process of becoming— as unfinished, uncompleted beings in and with a likewise unfinished reality."[9]

Another shift must be made from standardized IQ testing systems.

> There must be more to intelligence than short answers to short questions – answers that predict academic success; and yet, in the absence of a better way of thinking about intelligence and better way to assess an individual's capabilities, this scenario is destined to be repeated universally for the foreseeable future.[10]

This current system inflicts anxiety and stress on the learner to perform, and determines the learners eligibility for future privileges in our manufacturing oppressed society. How about we were to let "one's imagination wander freely, to consider the wider range of performances that are in fact values throughout the world?"[11] Moving away from this single score approach (which has a good deal of connotation and implication attached to it), and it is used across various age groups, and in diverse cultural settings. This in turn can give rise to adverse effect on culture elites.

Like our education systems we must shift our pedagogical tools to allow critical co-investigators, and move away from the teacher to student relationship to become a mentor and the learner, which is a healthier way of exploration. Removing labeling provides a chance of empowering learners of all humanity. Through personal interest, attention and curiosity. Touching on social, cognitive and identity exploration - Making choices that are valuable & beneficial to themselves and their environments. Through the process of becoming, it nurtures the learner's knowledge and ownership.

6 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, Pg71-72
7 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, Pg71-72
8 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, 81
9 Freire and Macedo. ***Pedagogy of the Oppressed.*** Chapter 2, 84
10 Howard Gardner, ***Frames of Mind: The Theory of Multiple Intelligences.*** Page 3
11 Gardner, ***Frames of Theory of Mind,*** Page 3

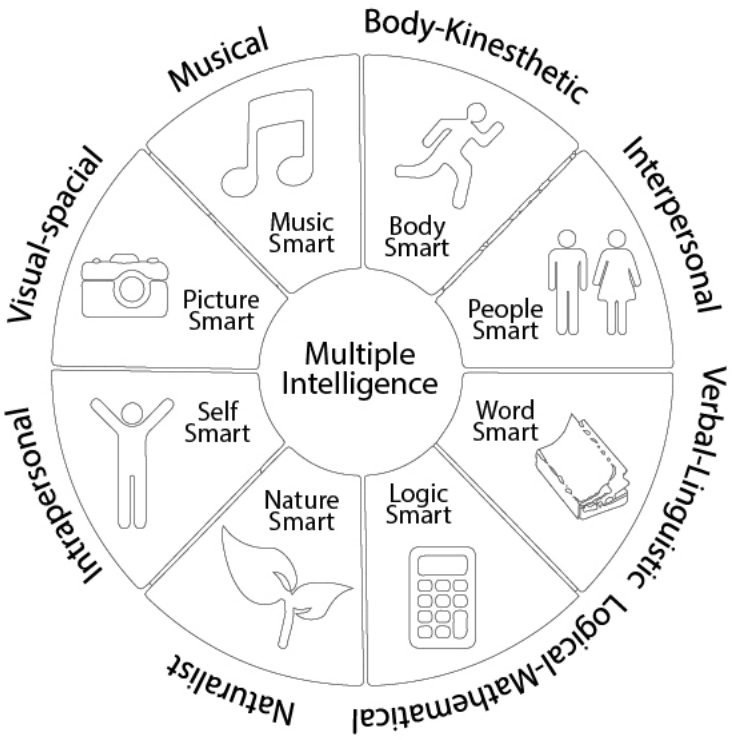
3. Theory and Alternatives

So, what are the alternatives? How do we connect with the learner's internal motivation, and inspire the act of becoming through self-direction and nurturing the learner's turning point of discovery? Consider Interdisciplinary science combining academic disciplines and the learner's abilities rather than disadvantages.

3.1 The theory of multiple intelligence

Howard Gardner outlines a new theory of human intellectual competences theory that returns to the characteristics of the revisionist theory. Which challenges the current classical view of intelligence moving away from subject based learning and IQ score limitations. Moving away from labeling disabilities and having a positive reflection on abilities. This, in turn in my opinion foresees a possibility of Interdisciplinary intelligence approaches?
The Frames of mind are as follows and as you can see on **Figure 1:**

Musical Intelligence
Spacial Intelligence
Naturalist intelligence
Linguistic intelligence
Bodily/Kinesthetic intelligence
Intrapersonal Intelligence (critical thinking)
Interpersonal Intelligence (good listeners and empathetic)
Logical and Mathematical intelligence



The theory of Multiple Intelligence

Howard Gardner

Figure 1

These 'frames' and the conviction that they exist - at least some intelligences, "that these are relatively independent of one another, and that they can be fashioned and combined in a multiplicity of adaptive ways by individuals and cultures, seems to be increasingly difficult to deny."[12] Our learning tools in turn needs to move away from creating pedagogical tools focus on singular intelligence or even focusing on one's disabilities and move forward to be more collaborative between abilities and disciplines. I believe this view can particularly have an adverse effect on learners with disabilities such as ADHD and dyslexia. Which also would coincide with what Sir George Still described ADHD as "an abnormal defect of moral control in children." He found that some affected children could not control their behaviour the way a typical child would, but they were still intelligent.[13] "If the framework put forth here is adopted, it may at least discourage those interventions that seemed doomed to failure and encourage those that have a chance for success."[14]

12 Gardner, *Frames of Theory of Mind*, Page 8
13 *"The History of Attention Deficit Hyperactivity Disorder."* no. 4 (December 2010)
14 Gardner, *Frames of Theory of Mind,* Page 10

3.2 The theory of successful intelligence

Looking at academic versus practical intelligence and a "notion that that people acquire knowledge without awareness of what is being learned is reflected in the common language of the workplace as people speak of "learning by doing" and "learning by osmosis.""[15] To learn from participation and involvement and to apply that knowledge in pursuit of personally valued ambitions and goals.

Robert J. Sternberg's theory see **figure 2,** also termed the triarchic theory, successful intelligence is the ability to achieve success in life, given one's personal standards, within one's sociocultural context. "Ability to achieve success depends on capitalizing on one's strengths and correcting or compensating for one's weaknesses through a balance of analytical, creative and practical abilities in order to adapt to, shape, and select environments."[16]

> Analytical questions address the ability to learn from context and reason inductively (i.e., the relation of intelligence to the internal world); creative questions address the ability to cope with novelty (i.e., the relation of intelligence to experience; and practical questions address the ability to solve real world, everyday problems (i.e., the relation of intelligence to the external).[17]

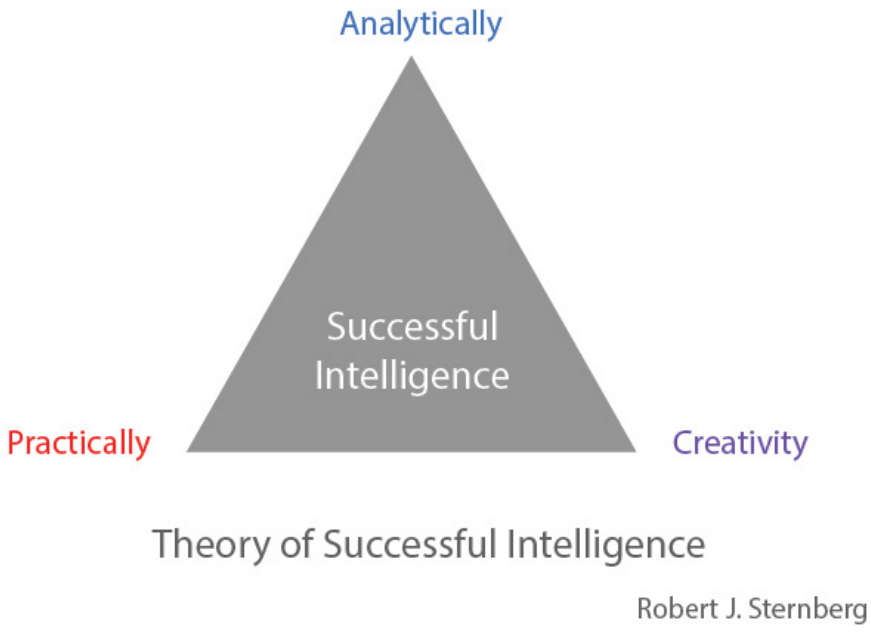


Figure 2

15 Robert J. Sternberg, *Practical Intelligence in Everyday Life.* Pg104
16 Sternberg, *Practical Intelligence* Pg92-93
17 Sternberg, *Practical Intelligence* Pg97-98

What distinguishes people who are more successful from those who are less successful in their everyday lives? Sternberg and his colleagues found in their research that much of the knowledge needed to succeed in real-world tasks is tactic. "It is acquired during performance of everyday activities but typically without conscious awareness of what is being learned."[18]

The current oppressive academic system offers problems that tend to be mapped by others. They are set out to only have one correct answer; providing information which is recited or portrayed without no analytical perspective. This teaching methodology is characterized to only have one outcome. Restricting the learner to bring their experiences and intrinsic interests into account, may see a different prospect or context.

> Practical problems offers a healthier approach to learning in contrast; discovery through personal interest; lacking in information necessary for solution; related to everyday experience; poorly defined; characterized by multiple appropriate solutions, each with liabilities as well as assets; and characterized by multiple methods for picking a problem solution.[19]

3.3 Critical Co-investigators

Problem-posing education, which breaks with the vertical patterns characteristic of banking education, can fulfill its function as the practice of freedom . . . Through dialogue, the teacher-of-the-students and the students-of-the-teacher cease to exist and a new term emerges: teacher-student with students-teachers. The teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach.[20] Placing the importance of the learner and being mindful of the process of becoming as an "unfinished character of human beings and the transformational character of reality necessitate that education be an ongoing activity."[21]

18 Sternberg, ***Practical Intelligence*** Pg104
19 Sternberg, ***Practical Intelligence*** Pg33-34
20 Freire and Macedo, ***Pedagogy of the Oppressed.*** Chapter 2, Pg80
21 Freire and Macedo, ***Pedagogy of the Oppressed.*** Chapter 2, Pg84

4. Mentor – Learner relationship

4.1 Respect

We must move away from this manufactured educational system where in fact the slaves to education, instead of striving for liberation, tend to then become authoritarian and dictators in their teaching. "To teach is not to transfer knowledge but to create the possibilities for the production or construction of knowledge."[22] Learning is an ongoing process therefore the teacher and learners must be both simultaneously teachers and students. There must be a respect for what students know. Taking the students past and current experiences of life, and discuss with the students the concrete reality of their lives. For example a learner's social, political, cultural, and ideological beliefs especially from those who may have experienced hardship can reflect on this and make a change for the better. Mentors must reflect on the knowledge "that speaks of respect for the autonomy of the learner, whether the learner be child, youth, or adult."[23] Therefore earning respect for each other and shifting away from authoritative teaching. In turn mentors must be careful to be empathetic and not sympathetic and practice the ethics of human solidarity by listening. Mentors are obliged to be a listener without prejudices. "To listen to the student's doubts, fears, and in competencies that are part of the learning process."[24] Mentors must consider and respect differences of other cultures and beliefs different from their own. In turn both mentors and learners must meditate the practice of patience and listen critically to each other.

4.2 Curiosity leading to knowledge

Mentors transform from the constraints, allowing for freedom, curiosity and this stimulates their capacity for risk, for adventure. Encouraging learners to remain curious and become capable of self-criticism. If the mentor themselves commits themselves to questioning in turn the learner will commit themselves to searching and may question themselves. "The more critically one exercises one's capacity for learn¬ing, the greater is one's capacity for constructing and developing "epistemological curiosity.""[25]

> If ingenious curiosity is characterised by experimentation, play, and trial and error, then epistemological curiosity is characterised by pursuing an exact method based on knowledge and expertise, usually informed by someone more experienced. One applies the method and principles to know more and more about the "something".[26]

"Ingenuous knowledge is the starting point from which his/her epistemological curiosity will work to produce a more critically scientific knowledge."[27]

22 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** New edition edition. Lanham: Rowman & Littlefield Publishers, 2001. Pg10
23 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg12
24 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg86
25 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg12
26 ebrace. ***"What Is Ingenious, Epistemological and Critical Curiosity?"*** School University Learning Partnerships. Accessed December 14, 2015.
27 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg42

4.3 Hope & Freedom & Adventure

My utopian view and hope would be to see that the learner has the freedom of expression and progress without limits and move beyond just the point of survival. Remove superiority of one person over another, of one race over another, of one sex over another, of one class or culture over another. A teaching of humanitarian values; generosity, respect for others, tolerance. Educators and learners alike should be open to unique and different developments, transformations and innovation. Being accepting and open minded to change, justice and to adopt a spirit of hope.

Learners today are being prepared for the inevitable in the view that things will not change, therefore the learner adapts themselves into a survival state.

> Intellectuals who memorize everything, reading for hours on end, slaves to the text, fearful of taking a risk, speaking as if they were reciting from memory, fail to make any concrete connections be¬tween what they have read and what is happening in the world, the country, or the local community.[28]

Learners must have a willingness and a taste for adventure and have the freedom to take risks from their mentors so their personal potential is an extension or progression of themselves and knowledge. Education must be progressive allowing learners to become curious, critical, bold and adventurous. As co-inhabitants in this world we need to learn to adapt to change in order to survive. With Globalization we are see major shifts in our societies. Currently we are seeing the big shift in migration and the movement of people from the Middle East, Asia, Africa, India & more due to war and climate change. Facing environmental challenges, therefore must learn to adapt rather than just survive in to new diverse cultures and also become agents of change. We must move away from this 'top down' pedagogical approach to learning. An environment must be structured where the learner has the right to prove the craziness of his or her idea. They must have the freedom to decide, even if they run the risk of making a mistake. To take ownership and responsibility for their own ideas and approaches.

> "Humanity is moving ever deeper into a crisis which has no precedent. It is a crisis brought about by evolution being intent on completely integrating differently colored, differently cultured, and intercommunicating humanity, and by evolution being intent on making integrated humanity able to live sustainably at a higher standard of living for all than has ever been experienced by any."[29]

28 Paulo Freire, *Pedagogy of Freedom: Ethics, Democracy and Civic Courage.* Pg14
29 R. Buckminster Fuller, *Critical Path pdf."* Accessed December 15, 2015.

5. Transcendent enlightenment – the act of 'becoming'

Learning is endless, humans are always driven by the will to keep moving and find out in order to develop their knowledge. "Impossible to recognize our human presence in the world as something singular and original. In other words, our being in the world is far more than just "being." It is a "presence," a "presence" that is relational to the world and to others."[30]

> If we reflect on the fact that our human condition is one of essential unfinishedness, that, as a consequence, we are incomplete in our being and in our knowing, then it becomes obvious that we are "programmed" to learn, destined by our very incompleteness to seek completeness, to have a "tomorrow" that adds to our "today." In other words, wherever there are men and women, there is always and inevitably something to be done, to be completed, to be taught, and to be learned.[31]

Learners can look at this unfinishedness, embrace it and use it in their advantage as responsible beings. Feeling unfulfilled as adults can make us seek out other directions in life. Although in younger learners this feeling of unfulfillment shouldn't come so early and that they should embrace in the concept that learning is a journey and not a race. Finding one's path in their own terms and seeing it as a life expedition. Learning is not a destination but a random journey. With societal expectations placed on learners to find their career choice or path place restrictions. The burden of providing or earning can make one make quick and rash decisions. Being a slave to consumerism and the pressure of perfection is also seeing learners become competitive with their peer groups. This applies to all age groups, right from the first test score they receive right through to University level and even in work environments. This enormous pressure of performance and competing can cause self-doubt, which can lead to anxiety and depression. These performance pressures can be seen very much in hyper-competitive communities such as Silicon Valley. At two top-tier high schools in Palo Alto, Calif., "the suicide rate is four times higher than the national average over the last 10 years."[32] "How am I doing?" In 1954, the social psychologist Leon Festinger put forward the social comparison theory, which posits that we try to determine our worth based on how we stack up against others."[33]

30 Paulo Freire, *Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*Pg6
31Paulo Freire, *Pedagogy of Freedom: Ethics, Democracy and Civic Courage.* Pg59
32 "*Top Silicon Valley High Schools Respond To Rising Suicide Rate.*" NPR.org. Accessed December 2, 2015.
33 Julie Scelfo, *"Suicide on Campus and the Pressure of Perfection."* The New York Times, July 27, 2015.

This unfinishedness is essential to our human condition. "To exist is to change, to change is to mature, to mature is to go on creating oneself endlessly."[34] Learners must embrace on their willingness to be complete or fulfilled in life but without losing their souls. Mentors can help learners list their achievements through embracing on who they are, instead of learners listing their accomplishments without necessarily knowing whom they are themselves. Freeing learners from limitations of their mind and free them from manufactured learning. Paying attention to the present moment, a conscious way of engaging in life and being mindful to become "more." Learning through the mind is limited. We are made of mind, the heart and soul and learning should involve these if truly effective learning is to take place. Learning should come from the inside out and mentors should become conscious of that, for themselves and for their students. "Teaching practice, which doesn't exist unless there is learning simultaneously, is a holistic practice."[35] Uniting the teacher and student. Man has lost their Holistic dimensions according to Fritjof Capra. Can we have learners and mentors simultaneously reach these holistic dimensions again. Having the learner reach the fullness they desire? Moving away from linear and analytical approaches of the mind. Approach the critical consciousness and reaching the transcendence of mind allowing learners to grasp their imagination, intuition and fantasy? Creating transcendent mentor-teacher relationships. Focusing on risk, honesty, freedom, mutuality, & compelling power.

Learning should be seen as infinity. It needs something more too. "It needs to become a kind of passion."[36] Allowing to express oneself without fear. "Living with what is different without fear and without prejudice, the more I come to know the self I am shaping and that is being shaped as I travel the road of life."[37]

34 Henri Bergson, ***Creative Evolution.*** Unabridged edition. Mineola, N.Y: Dover Publications, 1998.
35 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.***Pg68.
36 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg103
37 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg100

6. Geometrics and discovery

Mans consciousness is always evolving an endless stream of becoming, a life journey. "Every time man makes a new experiment he always learns more. He cannot learn less. "[38] Learning should be a discovery process in which it ascends.

> And he will thus be prepared to discover real duration there where it is still more useful to find it, in the realm of life and of consciousness. For, so far as inert matter is concerned, we may neglect the flowing without committing a serious error: matter, we have said, is weighted with geometry; and matter, the reality which descends, endures only by its connection with that which ascends.[39]

Can we have learners explore the environment allowing them to lead to new ways of thinking? Looking at living systems and synergy through the mathematical sequences such as Pi, Phi and Fibonacci? We are all geometricians and allowing learners to enhance their curiosity in the environment. Or learning across disciplines through geometrics and put into action the theory of multiple intelligence? Mixing logic/mathematical, with musical and spacial intelligence. Exposing the learner to alternative ways of thinking. One such school that looks at synergy and questions the co-inhabitants of the world and ourselves is Schumacher College, in Devon UK who's strapline is 'Transformative Learning for Sustainable Living'. Nature –based learning which looks into the depth of things and allows the learner to be investigative.
Our current learning system "is crushing curiosity right out of our next generation".[40] We need to move away from this and start creating 'agents of change' and have an equal and sustainable world possible through co-creation.

38 R. Buckminster Fuller, ***Operating Manual for Spaceship Earth.*** Edited by Jaime Snyder. Lars Muller Publishers, 2008. Pg99
39 Henri Bergson, ***Creative Evolution.*** Unabridged edition. Mineola, N.Y: Dover Publications, 1998. Pg103
40 "Michio Kaku: ***All Kids Are Born Geniuses, But Are Crushed By Society Itself."*** Off Grid Quest. Accessed September 27, 2015.

6.1 Buckminster Fuller – Design Science Revolution

One designer and inventor or as he liked to describe himself as a 'design scientist' had a different strategy to thinking and looked very closely at nature and systems thinking is Buckminster Fuller. He looked very closely to math and pulled inspiration from looking at the sky and sea. Like Paulo Freire, Fuller spoke of expectations of the learner after education.

> "We should do away with the absolutely specious motion that everybody has to earn a living. It is a fact today that one in ten thousand of us can make a technology breakthrough capable of supporting all the rest. The youth of today are absolutely right in recognizing this nonsense of earning a living. We keep inventing jobs because of this false idea that everybody has to be employed at some kind of drudgery because, according to Malthusian Darwinian theory he must justify his right to exist. So we have inspectors of inspectors and people making instruments for inspectors to inspect inspectors. The true business of people should be to go back to school and think about whatever it was they were thinking about before somebody came along and told them they had to earn a living."[41]

Fuller chose to embark on "an experiment, to find what a single individual [could] contribute to changing the world and benefiting all humanity."[42] Fuller was most famous for his lattice shell structures – geodesic domes, which have been used as parts of military radar stations, civic buildings, environmental protest camps and exhibition attractions. I hope to empower and inspire learners to explore nature to discover geometric shapes not to just find design solutions like Fuller did but to learn in the process. Possible learning mathematical patterns, scientific discovery or new art, inventions or design work. Just like Fuller's discovery of the geodesic dome. As a child he had trouble with geometry, being unable to understand the abstraction necessary to imagine that a chalk dot on the blackboard represented a mathematical point, or that an imperfectly drawn line with an arrow on the end was meant to stretch off to infinity.[43] He states "I am not trying to imitate nature I am trying find principles she's using."[44] Fuller devoted himself to be an agent of change. He vowed to apply inventory of experiences to the solving of problems that affect everyone aboard planet Earth.

> "Education either functions as an instrument which is used to facilitate integration of the younger generation into the logic of the present system and bring about conformity or it becomes the practice of freedom, the means by which men and women deal critically and creatively with reality and discover how to participate in the transformation of their world."[45]

41 LLC, New York Media. New York Magazine. New York Media, LLC, 1970.
42 *"A Three-Wheel Dream That Died at Takeoff - Buckminster Fuller and the Dymaxion Car - The New York Times."* Accessed December 14, 2015.
43 "Buckminster Fuller." Accessed December 15, 2015.
44 R. Buckminster Fuller, and Cam Smith. *Buckminster Fuller to Children of Earth.* 1st edition. Garden City, N.Y: Doubleday, 1972.
45 Freire and Macedo. *Pedagogy of the Oppressed*. Chapter 2, Pg34

7. Future Educational tools

What does the future of learning tools hold in the classroom? "Emerging technologies such as cloud computing, augmented reality (AR) and 3D are paving the way for the future of education in ways we may have yet to see."[46] "We are in an age of open information and many online courses are on websites and Apps such as Khan academy, edX and code academy to name a few."[47]

> There are many scary things about today's world, but what is truly thrilling is that the means of spreading both knowledge and inspiration have never been greater. Five years ago, a teacher or professor able to change the lives of his or her students could realistically hope to reach maybe a hundred of them a year. Today that same teacher can communicate through video to millions of eager students. There are already numerous examples of powerful talks that have spread virally to massive Internet audiences.[48]

When creating a technology tool we must be careful not to create something to replace the mentor but an additional tool. We have seen "the application of technological advances, which requires the sacrifice of thousands of people."[49] Holding on to the idea that the tool will empower the learner whilst maintaining ownership of the tool. Design a tool that speaks their language and nurtures their journey of exploration and feed on their own personal potential. "We need to find within technology that there is something we can do which is capable of taking care of everybody, and to demonstrate that this is so."[50] Can we inspire learners to take life long explorations of discovery just like Buckminster Fuller did with his dedication to his geodesic domes and his belief to take care of everyone, to design for 100% of the earth's inhabitants?

There are questions if technology in the classroom can be more harmful than good, with mentors and parents worried about overuse of social networking whilst learning can be a distraction. One solution we are seeing to this is virtual learning. For example Michael Bodekaer creates innovative science education using technology. He creates a virtual laboratory.[51] Creating dashboards where mentors know where their students are at. Their research showed that the impact of using the virtual laboratory learning increased by 76% over the use of traditional methods of learning. Even more interesting was when the mentor and virtual combined, this saw an increase to 101% in the learning effectiveness. The students were surprised that whilst they spent two hours on the virtual site they didn't check any social websites. Can these virtual technologies empower these young optimistic learners to create or experiment, which is out of reach for them?

46 "8 Technologies That Will Shape Future Classrooms." Accessed December 14, 2015.
47 Z, Kristyna. ***"The 37 Best Websites To Learn Something New,*** Medium, July 1, 2015.
48 John Brockman, ***This Will Change Everything: Ideas That Will Shape the Future.*** New York: Harper Perennial, 2009. Pg247
49 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.*** Pg96
50 ***"Norie Huddle Interview with Buckminster Fuller - Spring 1981."*** Golden Butterfly Productions. Accessed December 15, 2015.
51 TEDx Talks. Reimagining Education | Michael Bodekaer | TEDxCERN, 2015.

7.1 Scott Snibbe – phenomenological User interfaces and living systems

Snibbe looks at "interactivity" across mediums. "What I do is a seamless combination of software development, design, psychology, applying the principles of filmmaking, game design, visual art and music."[52]

I would like to look at future technology that enables learners to play an active part in change and exploring worlds beneath their fingertips but very conscious of virtual and authentic environments. For learners to make genuine articles through their exploration in the virtual dimensions. With passionate interests turned into active learning. Like Buckminster Fuller, Snibbe is very much inspired by living systems and nature, transferring into his interfaces. He looks closely at the link between users, actions and technology. He looked at creating dynamic interaction with a computational model, using human movement as the driving impulse, inspired by Paul Klee's Pedagogical Sketchbook.[53]
Figure 3 "We adopted the oriented primitives of pre-Cartesian geometry as the building blocks of our graphic environments: direction, velocity, orientation, and curvature."[54]

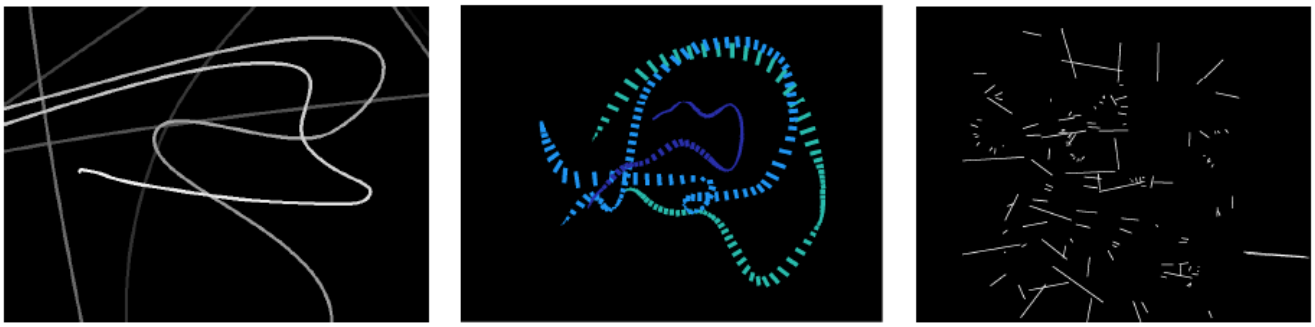


Figure 3

52 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015.
53 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015.
54 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015

In my design I would like to explore possibilities of highlighting the process of growth, empowerment, transcendence, unfinsihedness, becoming and progression all acts of learning which should be empowering through the visual representation of Pi, Phi and Fibanacci. Possibly mapping the learners journey, but also to inspire exploration of their own environments. I will touch on computational geometry like Snibbe and his complicated structures constructed of geometric interactive puzzles. The work of Snibbe holds particularly strong appeal for me personally, specifically how Snibbe looks at the relationships across natural and human disciplines.

Example 1

The Voronoi diagram **Figure 4** The structure of bubbles, the patterns of animal and community dominance, the patterns of cells and honeycomb, fishes scale patterns, the drying of desert sand and, in the first known drawing of a Voronoi diagram, Descartes's analysis of the gravitational influence of stars in 1644.[55]

Example 2

Snibbe also looks at the behaviors of ants in his piece Myrmegraph. **Figure 5** As the performer draws, he lays down both pheromone and ants. These ants are particles that obey a simple set of rules – they follow pheromone gradients stored invisibly in the image and have limits on their speed and turning to give them lifelike movement.[56]

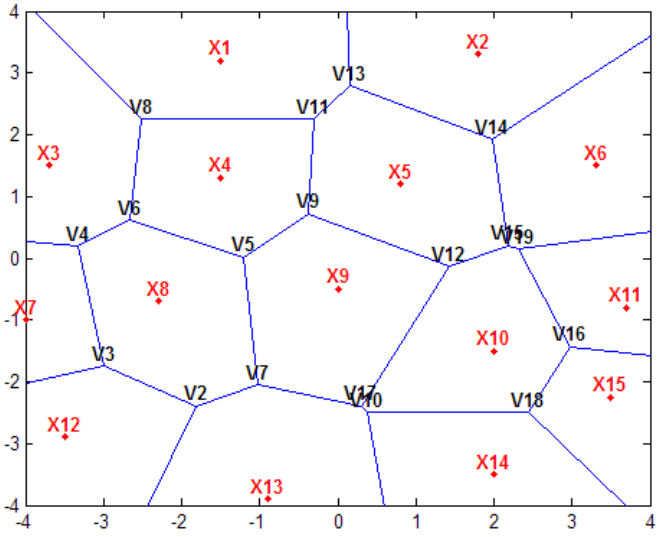


Figure 4: The Noronai diagram/ The Voronoi diagram

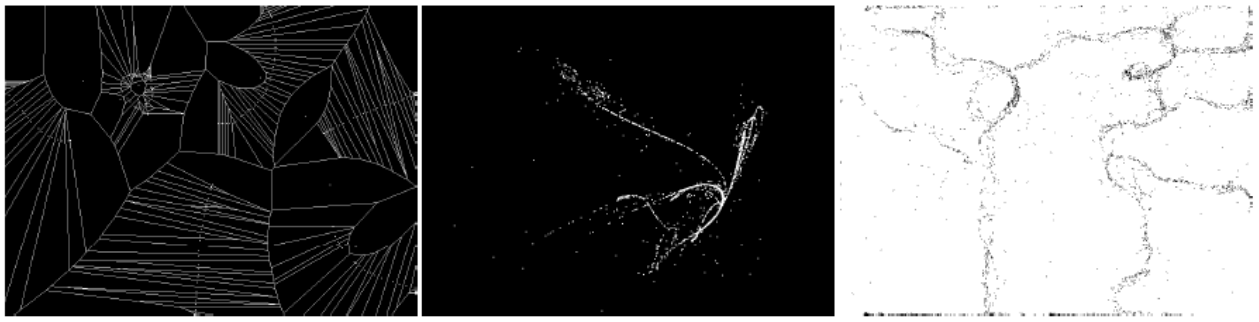


Figure 5

55 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015.
56 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015.

I am also very attracted to the work and exploration that Snibbe has done on Phenomenology – the study of how perception presents the world directly to consciousness.The dynamic abstract work presented here demonstrates a set of successful experiments in creating phenomenological user interfaces that directly engage the body.[57] I will looking at Transcendental Phenomenology and lived experiences. Looking at the geometry of the consciousness and a transcendence to enlightenment, leading to mindfulness in one's learning and experiences. Approaching the idea of how we are all gometricians.

> On the one hand, we have a mechanistic comprehension of history that reduces consciousness to a simple reflex of matter, and on the other, we have a subjective idealism that tries to make the role of consciousness fit into the facts of history. As women and men, we are not simply determined by facts and events. At the same time, we are subject to genetic, cultural, social, class, sexual, and historical conditionings that mark us profoundly and that constitute for us a center of reference.[58]

Our mind and cousiness is in an unfulfilled state - we are aware of our unfinisheness. We should be aware of this, making ethical decisions and putting them into into action and taking brave options.

> Philosophy is not only the turning of the mind homeward, the coincidence of human consciousness with the living principle whence it emanates, a contact with the creative effort: it is the study of becoming in general, it is true evolutionism and consequently the true continuation of science - provided that we understand by this word a set of truths either experienced or demonstrated. - Henri Bergson, Creative Evolution.[59]

57 "ABSTRACT - dynamicNPAR.pdf." Accessed December 14, 2015
58 Paulo Freire, ***Pedagogy of Freedom: Ethics, Democracy and Civic Courage.***
59 Henri Bergson, ***Creative Evolution.*** Unabridged edition. Mineola, N.Y: Dover Publications, 1998. Pg400-402

8. Conclusion

When I first started this process I was very focused on the removal of labeling learners to enable them to thrive. School reforms prove that our current system isn't working and we see alternatives to the system being introduced. I can see a shift away from 'teacher and student' to 'mentor and learner' relationships, through critical co-investigative techniques. I was very much focused on the learner but discovered that mentors too must be open to wisdom from their students. Interdisciplinary science combining academic disciplines and enabling the idea of Gardner's theory of multiple intelligence. Encouraging those that have a chance of success and enabling problem solving through cross-disciplinary learning. I speak of learning through experiences that can lead to innovation and entrepreneurialism. Stepping back from oppressing learners and techniques. Nurturing students to dream differently, encouraging their curiosity and love of life, removing the barriers of anxiety and fear of success. Experiences and discovery away from the classroom and connections to the natural world, and a taste for adventure becoming the focus. Learners should be curious, critical and bold in their endeavors. They should be empowered to be agents of change. It is important to allow them to use past experiences in their choices and outcomes of their innovation or investigative research - looking at Transcendental Phenomenology and being mindful. This approach allows the learner to trust in themselves to adapt to change and not fear it.

In my research I discovered that tactile knowledge is needed in the learning model and how future technologies can enhance this learning, in the classroom with virtual worlds and 3D printing already being introduced as a possibility to enhance knowledge for learners.

I spoke of mentors needing to be mindful of their students and be aware that learning is a process of 'growing' and that learning is ongoing through life's journey. That 'ownership' of the learner's journey is important too. Those discoveries are the property of the learner. I in turn must enable ownership for the learner in my design whilst attaching the importance to the mentor and learner relationship. Hoping to enable the learner to be intuitive to imagination and fantasy. Looking at the possibility to inspire learners to discover nature through geometric shapes and process these discoveries into tactile outcomes, possibly learning mathematical/logical patterns, sciences discoveries and even inventing their own Music, Art, Design and outcomes. Making a synergy of multiple intelligence and allowing learners to question us as co-inhabitants of the world. Being practical, creative and analytical of their outcomes. Like Fuller, learning through geometrics and finding the principles that nature is using. Whilst using Pi, Phi and Fibonacci as a metaphor of growth and a process of 'becoming'.

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