LEGO® Learning Institute

Defining Systematic Creativity

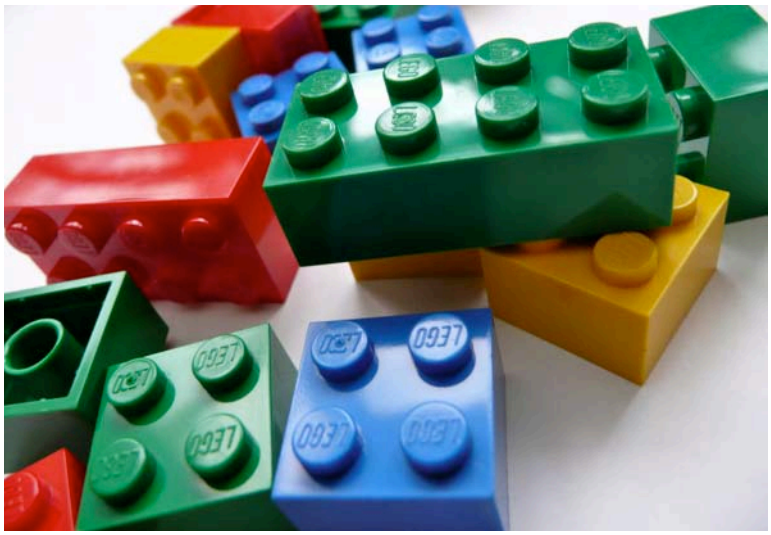
Explaining the nature of creativity and how the LEGO® System of Play relates to it.

Preface

What is creativity? What is the role of systems in creativity and learning? How does play support creativity and learning? What is the connection between creativity and learning? Is it possible that creativity and learning can be achieved systematically? How does the LEGO® System of Play support learning and systematic creativity?

These questions lie at the heart of this investigation into the latest research on creativity. We explore how intelligence, learning and creativity are intertwined — and the ways in which these capacities can be fostered and enriched through systematically supporting the development of a growth mindset and a related set of skills and abilities.

Final version, April 14, 2009



Introduction

In its simplest form Systematic Creativity is about using logic and reasoning along with creativity and imagination, to generate ideas or artifacts that are new, surprising and valuable.

Children learn about themselves, others and the world through play. Free play draws on curiosity and playfulness, the cornerstones of children's creative development. Curiosity encourages children to wonder why and to seek explanations, turning the unfamiliar to the familiar. Playfulness encourages children to imagine what if? and imagine how the familiar becomes the incongruous, or impossible.

Systems are crucial for creativity. Systems of science channel creativity towards solving specific questions, or problems, as in maths, physics, engineering. Systems of art channel creativity into many different and unique expressions, giving form to our imagination, feelings and identities, as in painting, music, sculpture.

LEGO is one of the few systems capable of channeling both. With LEGO you can bridge a stream, or transport an apple from A to be (scientific creativity) or build a fantasy creature, spaceship or landscape; or, as in LEGO Serious Play, create metaphors to represent feelings or identities (artistic creativity).

A system that bridges both scientific and and artistic exploration makes it possible to harness curiosity and playfulness simultaneously in pursuit of learning and creativity.

With LEGO products we learn how knowledge can actively be created and transformed by creative manipulation of systems. Building and experimenting is what sparks a child's imagination and sustains her interest and engagement: you get started and the ideas will come. You persevere and the ideas will fly. Through using open-ended and principled materials like LEGO bricks to make something (build/create), making things up (imagine/fantasise), play make believe (doing as-if/pretense) and story-telling, construction play and fantasy play can continuously feed one another, enabling us become familiar with inventive problem-solving through the act of play (playful learning).

We are all creative and can become more so through practice and by fostering the relevant mindsets behind the creative process (curiosity, mental readiness, confidence, positive framing and commitment). These 5 mindsets help us pursue a balance between the challenge and our abilities (Flow), between openness and closure and being able to re-frame the problem and focus are essential for being creative and for self-directed learning.

By learning to give shape and form to our imagination, by constructing and externalising concepts, making them tangible and shareable, we can not only reflect on them ourselves but invite others to reflect with us, allowing us to learn from both. This enables us to begin creating things that are new, surprising and valuable to us as individuals (being creative), but perhaps also to others – which is innovation.

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Executive Summary

Creativity is defined as *the ability to come up with ideas or artifacts that are new, surprising and valuable.*

Creativity is frequently mis-understood, rife with popular myths and perhaps most of all, assumed to be a single ability, which some people possess and others do not. Creativity is defined as *the ability to come up with ideas or artifacts that are new, surprising and valuable*. Research has shown that far from a single ability, creativity is made up of many seemingly ordinary qualities, such as conceptual thinking, memory, perception, and reflective self-criticism. Furthermore, anyone can become more creative with practice.

Types of creativity?

Creativity, it has been shown, can be divided into three different kinds:

1. *combinatorial* creativity — generating new, surprising and valuable ideas and artifacts through combining existing ideas and artifacts
2. *exploratory* creativity — generating new, surprising and valuable ideas and artifacts that expand our understanding of an area or creative domain
3. *transformational creativity* — generating new, surprising and valuable ideas and artifacts that transform the way we see the world

Furthermore, creativity occurs both on a personal, *psychological* level and on a social, *historical* level. Psychologically, *whenever an individual thinks a thought outside of all the thoughts familiar to her when s/he starts thinking, s/he is being creative.* If an individual thinks a thought the first time in the entire history of mankind, s/he is being creative not only on a psychological, but on a historical level.

This historical level is harder to evidence as it is heavily laden with cultural perceptions of what is novel, surprising and valuable and these concepts continue to be disputed. This document focuses primarily on the psychological kind of creativity, as defined by constructivist and socio-cultural approaches.

What is the creative process?

Research has shown that far from being random or unpredictable, the creative process is at once iterative and convergent. Creators, move through five phases, which have been defined (and generally recognised) as:

1. *Preparation:* becoming immersed in problematic issues that are interesting and arouses curiosity,
2. *Incubation*: ideas churn around below the threshold of consciousness,
3. *Insight,* or illumination: the "Aha!" moment when the puzzle starts to fall together,
4. *Evaluation,* or verification: deciding if the insight is valuable and worth pursuing,
5. *Elaboration:* translating the insight into its final work.

Although this list of phases appears to suggest a linear progression, the process of developing ideas or artifacts is seldom so straightforward. One often has to re-visit previous phases and iterate the idea as new insights emerge. This *ability to iterate* is a vital element in both learning and creativity, as is the *concept of Flow*, allowing one to perform at the peak of one's abilities.

The conditions for this optimal, productive state to emerge is that *one's abilities are in balance with the challenge at hand* – which is a pre-requisite not only for creativity, but also for learning and in fact, any human activity where peak performance is desired. A person's ability to balance openness and closure, change and stability, and to be able to re-frame the problem and focus are further elements particular to becoming self-directed in one's creative ability.

"Far from being random or un-predictable, the creative process is at once iterative and conver-gent"

"Systems have been proven to be essential for creativity"

What is the role of systems in creativity?

Systems have been proven to be essential for creativity, not only because *through systems we channel creativity into ideas or artifacts* in a way that they can be understood and valued by ourselves as well as others. Systems of science channel creativity into solving specific problems (as in maths, physics and engineering). Systems of art channel creativity into unique expressions, giving form to imagination, feelings and identities (as in painting, music, sculpture).

Systems are also used by the mind to generate meaning from the endless onslaught of stimuli from the external world, and furthermore *we rely on systems to expand our understanding of the world*. It appears that the *constructivist idea of building knowledge by making something*, has a far deeper impact on our learning, because we engage both mentally and physically with the subject matter. Thus *systems that allow us to build knowledge, as well as express it, become crucial not only for learning, but also for creativity*.

What is the role of play in creativity and learning?

Children develop the pre-requisites for creative ability through free play, where the elements of curiosity and playfulness are called upon. Children learn about themselves, others, the world and about expressing their creativity through play.

Curious minds seek evidence, ask why questions, and offer causal explanations ("if then" statements), turning the unfamiliar into the familiar. *Playful* minds, in contrast, subvert "realities" into fantasy or fiction and ask what-if questions, turning the familiar into the incongruous. When successful, both curious minds and playful spirits create and inspire, yet they do so in different ways, engaging different parts of a person's mind in an enriched dialogue, setting the stage for combinatorial, exploratory and transformational kinds of creativity to occur.

Both curiosity and playfulness manifest themselves in children's pretense and role-play. Combining role play and imagination into *making things (build/create), making*

things up (imagine/fantasise), make believe (doing as if/pretense) as well as when sharing our stories are ways children engage with things that are meaningful to them. These ingredients of play are intrisically linked, inseparable and fuel the process of learning through play, or 'playful learning', where children invent alternative ways of doing something or seeing something.

Meaningful learning requires a period of open-ended 'playing around' with alternative ways of doing things. Constructive play, by definition, builds on itself to increase the competence of the child. The competence, in turn, increases the child's pleasure by making even more creative acts possible. The cycle repeats itself, with the new creative acts becoming yet another form of play at a higher level of understanding until they are mastered. Development, as Piaget phrases it, "is a spiral of knowledge moving upward through alternating play and skill". Meaningful learning is more likely to occur when the child herself invents the alternative ways of doing something - as the chances are that she will also better understand how that new way relates to the other ways she is familiar with from the past. Although things are rarely this simple, the point remains that invention by the child is essential to constructive play and playful learning.

What is the connection between creativity and learning?

Systems create an intimate link between creativity and learning, in that we use systems in our mind to generate meaning, explore our understanding of the world, as well as express our understanding through systems.

Constructionism brings this relationship even closer as the idea of an *optimal learning environment is one where the activity engaged in is perceived as meaningful, one's abilites are in balance with the challenge at hand, and one has the tools to express the emerging knowledge*. In such a context one becomes a self-directed learner and actively pursues learning for its own sake, out of intrinsic motivation.

Thus the process of preparation, incubation, insight, evaluation and elaboration actually lends itself very well not only to understanding the phases of creativity, but also learning, yet with a crucial difference.

The *objective of the creative excercise is to generate ideas or artifacts* that are new surprising and valuable, whereas the objective with *self-directed learning is to generate knowledge or explanations of the world that are new, surprising and valuable for the individual*.

Systems that allow for creativity and learning to inter-twine by stimulating the imagination and allowing shape to be given to it, are crucial in helping us to break free to see things in a new way, whether to generate ideas and artefacts or indeed to learn something new.

Can learning and creativity be achieved systematically?

Research highlights the importance of mindsets in one's ability to become a successful self-directed learner or indeed, perform at the peak of one's abilities. This understanding stems from research into two basic theories of intelligence that, if projected onto self, affect how a person gauges her abilities to face challenges and handle problematic situations. Individuals who have "fixed" mindsets view intelligence as an unchangeable mental gift that cannot be bettered from within. By contrast,

"At the heart of the creative process is the ability to control one's focus, to diverge and converge as needed in order to re-frame a problem"

individuals with "growth" mindsets believe that intelligence is malleable, and thus can be optimized through will and work.

Empirical studies bring strong evidence to the further notion that students with fixed mindsets are less likely to engage in challenging tasks, and become helpless in situations where they feel judged, and because they feel helpless, they tend to attribute their successes and failures to others: they have an *outer locus of control*. By contrast, students with growth mindsets believe that, to a great extent, they can impact their abilities, and thus recover more easily when failing or being judged: They have an *inner locus of control.* It has further been shown that our beliefs about our success not only impacts our concept of intelligence, but also our ability and ways — to learn and be creative. Equally important, research seems to indicate that it is possible to change mindsets by encouraging a different way of thinking and creating the conditions for a growth mindset to take root.

Building on this work, specific mindsets for successful learning have been identified as *curiosity, courage, exploration & investigation, experi-mentation, imagination, reason & discipline, sociability and reflection.*

In sports psychology, the notion of *focus* and the ability to maintain focus in the face of adversity is highlighted as the key differentiator behind superior athletic performance, and in this context the mindsets of *commitment, mental readiness, positive visions & images, confidence, distraction control and on-going learning* are pin-pointed as qualities athletes can deliberately work on to improve their ability to focus, and thus master excellence in their sport.

Judging by the above, developing mindsets emerge as crucial in many areas, including mastering excellence in sports. Said otherwise, without an ability to focus and the pre-requisite "positive" mindsets, both learning and creativity can become more haphazard (driven by an outer locus of control) rather than systematic.

At the *heart of the creative process is the ability to control one's focus, to diverge and converge as needed in order to re-frame a problem* – use imagination to break off beaten paths to find new ways. The mindsets of *curiosity, mental readiness, confidence, positive framing and commitment* emerge as the key mindsets behind an optimally functioning creative process. They fuel each of the stages of the creative process, including the iteration between phases bourne out of the ability to use focus to frame the problem in more fruitful ways, giving rise to new ideas.

Thus we propose that four elements are necessary for creativity and learning to become something individuals can engage in systematically:

- *cultivating the relevant mindsets* behind optimal learning and creativity
- *learning to iterate* by controlling one's ability to focus and use divergent and convergent thinking appropriately to re-frame problems in order to enable new, surprising and valuable ideas or artefacts to emerge
- *building to understand*, creating a profound understanding of a topic as well as making it meaningful through investing the self in the process of making it. This engages know-how and the unconscious, which is more robust and resilient, more resistant to disruption, than our conscious abilities. Furthermore we are able to use a range of strategies to manipulate the physical object in a way that brings learning and sparks our imagination, without making the mastery of the mental heuristics a pre-condition for success.
- *mastering a tool.* Once creators have acquired the skills and confidence to express and communicate ideas using a certain tool (or set of tools), this tool becomes second nature and enables self-directed learning and creativity through the ability of exploring a wide array of subject matter through the use of the preferred tool.

How does the LEGO® System of Play support creativity and learning?

LEGO bricks are an unusual system in that they enable the channeling of both scientific and artistic kinds of creativity, simultaneously. Systems of science channel creativity in particular directions, towards specific questions; whereas the systems of art forms, such as music or oil painting, offer more of an 'open palette' to the creative individual.

The LEGO System provides the tools through which a problem can be solved (ex. how to transport an apple from A to B, or how to bridge a stream), or can offer a palette of opportunity for open creative expression (ex. building a fantasy creature, spaceship or landscape; or, as in LEGO Serious Play, creating metaphors to represent feelings or identities).

Akin to the full spectrum of creativity itself, the LEGO System embraces both the scientific and artistic kinds of creativity and enables individuals to engage both in an enriched dialogue. Much like one can listen and appreciate music, dabble with making sounds on an instrument, play music from the score or indeed improvise or 'jam' with

others in a band - the LEGO System enables constructive play, which like playing a musical instrument, helps children bring their imagination to life through a process of open exploration, or intelligent form giving, both alone and together with others. This process is both free and constrained, loose and principled. In the case of music, the forms that emerge are aural, in the case of LEGO bricks, they are tangible.

This wide range of ways to engage with the system, along with its ability to bridge both kinds of creativity means the LEGO System lends itself very well to both learning and creativity - its versatility can be detailed as follows:

1. **An interconnecting set of parts**. Connections come easily and sometimes in unexpected ways.
2. **A low entry level for skills**, anyone can pick up LEGO bricks and make something satisfactory
3. **A medium for mastery** the system can be used to create both very simple and very complex constructions.
4. **The ability to create something where previously there was nothing** – coupled with the lack of need for preparation and planning: as they say in LEGO Serious Play, 'If you start building, it will come'.
5. **An open system with infinite possibilities.** It can grow in all directions and the parts can be combined in limitless ways.
6. **A belief in the potential of children and adults and their natural imagination** – that anyone can make and express whatever they want to, through the system.
7. **A belief in the value of creative play**, and a respect for play as a powerful vehicle for learning and exploration.
8. **A supportive environment** in which different ideas can be tried out and experimented with, with no negative consequences. On the contrary, it is common that one good idea leads to another.
9. **The LEGO® System grows with the person,** from the youngest child to the grown-up adult user
10. **The LEGO System also grows *beyond* the person:** at all levels of engagement with LEGO products, from Duplo® to the world of the AFOL, LEGO bricks are a social tool, fostering connection and collaboration.

"The LEGO System grows beyond the person: at all levels of engagement, LEGO bricks are a social tool, fostering connection and collaboration"

Contents:

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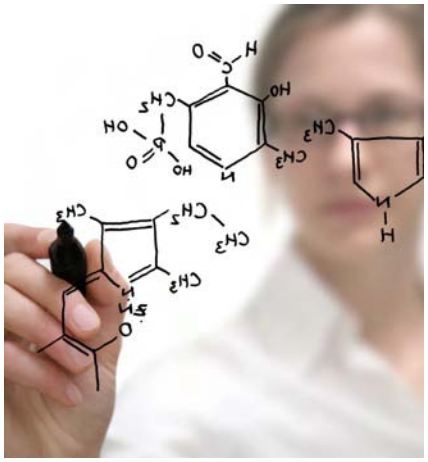

Background

Why try to define Systematic Creativity?

Godtfred Kirk Christiansen, the founding father of the LEGO® System of Play, believed that children should not be offered ready-made solutions, instead they needed something different that would strengthen their imagination and creativity. He devised the notion that a range of toys should be put together to form a system, in order to create a toy with value for life as well as bring order to the sprawling toy sector of the time. A patent application was made for the LEGO® brick in 1958.

'Our idea has been to create a toy with value for life – a toy that appeals to children's imagination and develops the urge to create and the joy of creation, which are driving forces in every human being'[1]

In 2008, 50 years later, the LEGO brick has become part of popular consciousness, an indelible part of the childhood memories of many the world over and almost a generic symbol for creativity and the exuberant optimism and desire of children to imagine what could be and to create that vision with their own hands.

The LEGO brick has won the acclaim of 'Toy of the Century'[2] and recognised in countless other ways. Despite its near ubiquity as a symbol for creativity, little insight exists as to just why an open-ended system like the LEGO brick is such a powerful tool for creativity.

This is evident in a recent study with parents of LEGO Kids Inner Circle members in the US[3], parents were asked what impact they feel playing with LEGO products has had on their children. Over 90% of these parents feel LEGO play has had a positive impact on numerous developmental skills:

- Creativity
- Problem-solving
- Coordination
- Thinking
- Learning
- Engineering
- Reasoning

1 Godtfred Kirk Christiansen in *LEGO - NYT* (Billund: October 1955)

2 http://www.toyretailersassociation.co.uk/toty/totc20.htm accessed 18/11/2008

3 LEGO Kids Inner Circle (2007): *Family Together survey* with parents of members

However, despite this strong testimony, most parents have limited or no understanding of why and how LEGO play helps their children grow. The same holds true for many educators who see the benefits in their students when using LEGO® Education products, but find it hard to articulate precisely what it is about LEGO play that helps students think, learn and grow.

Meanwhile, creativity is a widely discussed topic in the media, highlighted as the skill for the future, fueled by the arguments of what the impact of children's growing reliance on computer entertainment has on their development and creativity[4].

Creativity has also become a growing priority if not a trend in its own right among forward-looking business leaders who know that in today's world, imagination and creativity are as crucial for business success as is knowledge.

In addition, a number of prominent business minds, innovators and scientists all list LEGO products as having had a significant influence in their childhood. The founders of Google, Sergei Brin and Larry Page, publicly attest to using LEGO bricks as a means to facilitate creative brainstorms in their current work[5] — these stories further cement the LEGO System more as a medium and facilitator of the creative process than merely a toy with a purpose to entertain.

If this is indeed the case, the argument for the LEGO System as a facilitator of creativity through a tactile means to explore an iterative design process is obvious, further supported by the wide-spread use of LEGO Serious Play as a business innovation tool.

Therefore an investigation into defining what the notion of Systematic Creativity is and what it encompasses seems warranted. An improved understanding of this can help not only children, parents, teachers, and entrepreneurs, but society at large in how to capitalise on the fundamental human driving force of creativity.

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4 Steven Johnson, *Everything Bad is Good for You*, Penguin Books, London, 2005.

5 http://www.time.com/time/magazine/article/0,9171,1158956,00.html / accessed September 2008

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Chapter 1

What is Creativity?

What is creativity?

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Creativity is a prized feature of the human mind, yet equally widespread is the puzzlement about the nature of creativity and its origins. The first and most fundamental question is inevitably: What is it? How should creativity be defined and is every novel idea a creative one? If not, what is the difference? Is creativity something you are born with or something you can nurture, systematically?

Margaret Boden defines creativity as the ability to come up with ideas or artifacts that are *new, surprising, and valuable*[6]. "Ideas," or thoughts, include concepts, insights, held beliefs and theories (the inner face of creative expression). “Artifacts” or things man-made, include poems, paintings, musical compositions, cooking recipes, sculptures, steam-engines, vacuum cleaners, pottery. (the outer face / tangible form / expression of ideas).

As these very diverse examples suggest, creativity enters into virtually every aspect of life. It’s not a special "faculty," but an aspect of human intelligence. It’s not about being an artist or a scientist, but about being inventive, innovative, intelligent, and ultimately, adapted. In other words, creativity is grounded in everyday abilities such as conceptual thinking, perception, memory, and reflective self-criticism. Every one of us is creative, to a degree and can get better, if working at it. When we are engaged in the act of being creative, we feel we are performing at the peak of our abilities. Creative works give us insights and bring insights into being — making them tangible and shareable, enriching our lives.

Three Forms of Creativity: Combination, exploration and transformation

According to Boden creativity can happen in three main ways, which correspond to the three sorts of surprise:

Combination

An idea may be surprising because it is *unfamiliar, or even unlikely.* For instance, in the field of space travel, it was initially believed that highly streamlined shapes would be best for re-entering the earth's atmosphere; however, experiments showed that blunt-shaped re-entry bodies would make the most efficient heat shields when returning to earth from space

This first form of creativity involves making unfamiliar combinations of familiar ideas. The resulting idea is surprising, because it is unfamiliar or may even seem unlikely. Examples include poetic imagery, collage in painting or textile art, analogies or even video mash-ups. These new combinations can be generated either deliberately or, as often is the case, unconsciously. Both making and appreciating a novel combination requires knowledge in the person's mind, and many different ways of moving around within it.

If the novel combination is to be valued, it has to have some point beyond being an outcome of a purely random process – like shaking marbles in a bag. The ideas/marbles have to have some intelligible link between them for the combination to 'make sense'. Even if two ideas are put together randomly, they are retained/valued only if they can be associated with or assimilated into previously held ideas and or familiar experiences[7].

Exploration

The second sort of surprise occurs when an unexpected idea 'fits' into a style of thinking that you already had – but you are surprised because you hadn't realised that this particular idea was part of it. Maybe you are even intrigued to find that *an idea of this general type fits* into the familiar style.

Within a given conceptual space or domain (examples include ways of writing prose or poetry, styles of sculpture, painting or music; theories in chemistry or biology; fashions in couture or choreography) many thoughts are possible, only some of which may actually have been thought. Some spaces, of course, have a richer potential than others.

Whatever the size of the space, someone who comes up with a new idea within that style is being creative in the second, exploratory sense. If the new idea is surprising in the way it 'fits' into a style of thinking that you already had, you have expanded the conceptual space through creative exploration. If it leads on to others (still within the same conceptual space) whose possibility was previously unexpected, better still. Exploratory creativity is valuable because it can enable someone to see possibilities they hadn't glimpsed before and learn more about the conceptual space. They may even start to ask *just what limits,* and *just what potential*, this style of thinking has[8].

Transformation

The third kind of surprise is the astonishment you feel when coming across an apparently *impossible* idea. It just couldn't have entered anyone's head, you feel – and yet it did. It may even engender other ideas which, yesterday, you'd have thought equally impossible.

As opposed to the fixed realities of say, geography and the maps that illustrate them, the maps in our heads of the conceptual space or domain, favoured by our communities, can change – and it's creative thinking which changes them. Some changes are relatively small and relatively superficial, whereas others are comparable to re-routing the motor-way (in 'real-life' as in the mind).

The supposedly impossible idea and subsequent astonishing surprise can come about only if the creator changes the pre-existing style in some way. It must be tweaked, or even radically transformed, so that thoughts are now possible which previously (within the untransformed space) were literally inconceivable. The deepest cases of creativity involves someone thinking something which, with respect to the conceptual space in their minds, they *couldn't* have thought before[9].

7 Boden, The Creative Mind, p.3.

8 Boden, The Creative Mind, p. 4.

9 Boden, The Creative Mind, p. 5.

Two Different Senses of Creativity

Boden further distinguishes between two senses of 'creative'. Both are common in conversations and writings about creativity, and (although the context often supports one or the other) they are sometimes confused.

One sense is *psychological* (Boden calls it P-Creative for short), the other *historical* (H-creative). The psychological sense concerns ideas (whether in science, needlework, music, painting, literature) that are surprising, or perhaps even fundamentally novel, with respect to the *individual* mind which had the idea. If Mary Smith combines ideas in a way she's never done before, or if she has an idea she could not have had before, her idea is P-creative – no matter how many people may have had the same idea already[10]. The same holds true of a young child who realises, for the first time, that others see the world differently than she does, or that things continue to exist when out of sight. These realisations are novel, surprising, and immensely valuable. Yet, others have had them before. Both Mary Smith and the young child are P-creative in Boden's sense: they are *thinking a thought that is outside the space of thoughts that is even conceivable to that person [when she starts thinking].*

The historical sense applies to ideas that are novel with respect to the *whole of human history*. Mary Smith's surprising idea is H-creative, according to Boden, only if no one has *ever had that idea before her*. It may be an H-creative 'combination', or it may be an H-creative 'impossibility'. But whichever type of creativity is involved, it's historically creative only if no one has had that thought before. Or to rephrase according to Czikszentmihalyi, H-creative things are those that become noticed at a particular juncture. They may have been 'thought of' and even developed many times before, but H-creativity is that which becomes part of our historical narrative.

People can be credited with creativity in two senses. Someone who is P-creative has a (more or less sustained) capacity to produce P-creative ideas. An H-creative person is someone who has come up with one or more H-creative ideas. Although H-creativity is the more glamorous notion, and is what people usually have in mind when they speak of 'real' creativity, P-creativity is more important for our purposes.

However, it is important to bear in mind that creative contributions (scientific inventions as well as everyday innovations) are rarely either individual (P-creative) or historical (H-creative) in nature. Instead, most surprising and valuable ideas spread within cultures and novelties emerge somewhere in-between P and H. What matters, in other words, is the intertwining between personally meaningful and culturally (as well as historically/generationally) relevant — contributions.

For a more nuanced approach — reference Kuhn's concept of scientific revolutions and paradigm shifts.

10 Boden, *The Creative Mind*, p. 43.

Values and creativity

As touched upon above, the three forms of creativity may occur on an individual level, but the assessment of whether an idea, whether a combination, exploration or transformation — will be considered valuable or have an impact beyond the individual is up to the field (or players) of a given domain or culture to determine.

Boden points to the two definitions of 'new', i.e new to an individual (P-creativity) or new to mankind as a whole (H-creativity). No one can reasonably name the different meanings the word 'valuable' has as our aesthetic values are difficult to recognise and articulate. Moreover, they change. They vary across cultures and even within a given 'culture', they are often disputed: different subcultures or peer groups value different types of dress, conventions, jewellery, music etc. Where transformational creativity is concerned, the shock of the new may be so great that even fellow artists find it difficult to see value in a novel idea. Even in science, values are often elusive and sometimes changeable.

The origin and long-term survival of an idea and the extent to which it is valued and disseminated at any given time, depend on many different things. Shared knowledge and shifting intellectual fashions are especially important (and are partly responsible for the many recorded cases of 'simultaneous discovery'). Other factors are relevant, too: loyalties and jealousies, finances and health, religion and politics, communications and information storage, trade and technology. Even storm, fire and flood can play a part: think of the burning of Alexander the Great's library[11].

Because creativity *by definition* involves not only novelty but value, and because values are highly variable, it follows that many arguments about creativity are rooted in disagreements about value. Sawyer highlights that 'for sociologists there is no such thing as objective, timeless, true creativity: creativity can only be identified and judged within a social system' [12]. The social system includes complex systems of social networks (the field) and complex languages and systems of conventions (the domain).

"Many arguments about creativity are rooted in disagreements about value"

11 Boden, The Creative Mind, p. 45.

12 Keith Sawyer, *Explaining Creativity — The Science of Human Innovation*, Oxford University Press, Oxford, 2006, p. 134.

Furthermore only a socio-cultural approach can explain those creative products that are generated by large, complex groups of people — movies, video games, computer applications — or by small, intimate ensembles like jazz groups or brainstorming work teams. Our creativity myths generally lead us to try to identify the creator who is responsible for such group products, but this is often an impossible search as there is no single creator for many of these modern creative products[13].

It thereby follows that societies play a strong role in defining the creative ideal and depending on society, these ideals can vary drastically. Sawyer references the amazing variety of cultural practices and beliefs around the world, documented by anthropologists. Of all the ways to compare cultures and cultural ideals around creativity, perhaps the most widespread is the individualism – collectivism contrast. Collectivist cultures are those in which people are integrated into strong, loyal groups. These cultures value group goals and outcomes over the individual. The self is defined by reference to the group and to one's position in it; there is not a firm separation between individual and group.

In individualist cultures, by contrast, the ties between individuals are looser. Individualist cultures value individual needs and interests over those of the group, and they value personal outcomes and goals more than social relationships. The self is defined as inner property of the individual, without any necessary reference to the group. Of course, there are differences in degree; even individualist cultures may have some collectivist elements and vice versa.

Cross-cultural studies have shown that the U.S culture is extremely individualist. In individualist cultures – like the United States – individuals emphasise how they are unique, different and better than others. They tend to see themselves as separate from others. In such cultures, people believe that artists embody these traits to an extreme – artists are unique, more different, and more separate than the average person. In collectivist cultures, in contrast, people emphasise that they are ordinary, similar to, and no different

"Our creativity myths generally lead us to try to identify the creator who is responsible for such group products, but this is often an impossible search as there is no single creator for many of these modern creative products"

13 Sawyer, Explaining Creativity, p. 134.

from others; and rather than separateness, they emphasise their connectedness also in creative output[14].

That being said, in today's world, the very distinction between 'individualist' versus 'collectivist' mindsets, or cultures are shifting. There is growing evidence that today's kids/youth (referred to as 'digital natives') are living part of their lives 'on screen', to use Sherry Turkle's expression. In doing so, they become active players in online communities and they develop their own ways of thinking, and relating, beyond their culture of origin. Ackermann puts it boldly when she asserts that today's 'natives' share before they think, and they go public (externalise thoughts) before thoughts are 'ripe'. They often borrow and address fragments of ideas or creations in a cut-and-paste manner. As a result, their intelligence is more 'connective' (to use Derrick de Keerkhove's term) than it is 'individualistic' or 'collective' (as Levy put it). Contributions remain personal [singular] yet they are quickly passed on, built upon, and jointly crafted to their finish.

The origins of Western conceptions of Creativity

If we take seriously the dictionary-definition of creation, 'to bring into being or form out of nothing', creativity seems to be not only unintelligible but strictly impossible. No craftsman or engineer ever made an artefact from nothing. To define creativity psychologically, as 'the production of new ideas', hardly helps. for how can novelty possibly be explained? Either what preceded it was similar, in which case there is no real novelty. Or it was not, in which case on cannot possibly understand how the novelty could arise from it. Again we face either denial or magic.

In the western world creativity has always had romantic connotations closely connected to the world of divine gods and moments of epiphany only granted the few special prodigies and not as a constant feature of people and society to deliberately strive to improve the livelihood and the conditions people live under.

To a certain extent these myths and beliefs have prevented everyday people from associating creativity with the main premises for humanity. Sawyer explains that the notion of the artist to be of high social status being recognised for his divine talent is no more than 200 years old. Before then social status was based on economic success and artists had much lower status than other craftsmen like butchers and blacksmiths who were much more financially successful.

This societal order changed in the 14th century during the renaissance. Artists were all of a sudden recognised for their knowledge and genius because of the new found interest of nobility in immortalising themselves through paintings. This was to mark the beginning of the modern perception of the artists as Sawyer expresses it: "that artists are independent from society's normal standards of taste, that artists are inspired innovators, and that the function of art is to communicate the inner insights of the artist to the viewer."[15]

How did this historical change influence and shape the understanding of creativity? The answer to this question is not found in the actual expression of the artists but in the inspiration behind their artistic expression.

14 Sawyer, Explaining Creativity, p. 140.

15 Sawyer, Explaining Creativity, p. 13.

Sawyer describes two dominant ideologies that have defined creativity at various points in the last two centuries: Rationalism and Romanticism. “Rationalism is the belief that creativity is generated by the conscious, deliberating, intelligent, rational mind; Romanticism is the belief that creativity bubbles up from an irrational unconscious, and that rational deliberation interferes with the creative process”[16].

Two ways of thinking that at first seem contradictory, but at the same time they share one key principle the idea of that creativity comes from an external source either the universal order of the world or the divine truth of the unconscious only granted to a few and chosen individuals. What confuses the argument further is contemporary neuroscience which largely supports the notion that cognitive processing (which is rational-sounding) is bubbling away in the unconscious (which sounds romanticist). The influences of these two historical points of views have been the very foundation of the cultural myths that surround creativity nowadays and the bridging of both indirectly through neuroscience, allows them to live on as myths in contemporary society.

But why is it that these myths have been able to define creativity for two centuries? According to the semiotist Roland Barthes (1979) myths are essential in creating cultural meaning because they are capable of fusing different perceptions into a new context and at the same time making it seem like the norm in a given time and place. A myth is a set of ideas that have acquired meaning through learned behaviour and thereby become a system of shared signs (communication). In other words it is the combination of meanings from different social, historical, and cultural contexts that makes up the myth. This in turn implies that the myth does not have a fixed nature but its meaning is negotiated by its users and how they use and ascribe cultural values to it.

16 Sawyer, Explaining Creativity, p. 15.

Myths about Creativity

The following section aims to capture common myths about creativity and their background. In some cases, a 'myth' may be based on truth, but has acquired mythological status through woolly thinking and exaggeration.

1. Myth: You have to be an artist to be creative! — False There are many creative engineers, scientists, financiers, and entrepreneurs. Creativity is not a privilege reserved to poets and artists alone. Nor is it a characteristic of loners, misunderstood geniuses, or crazy people, It is *about invention and innovation, often by teams!*

2. Myth: Creative people are mostly rebels (won't play or play only by their rules) — True and False As we are beginning to understand the "game" of creativity, we know how minds form patterns [in which they then get caught], and what it takes for people to *move across patterns* to generate new ideas [serious play][17].

You don't need to be a rebel to enjoy the sense of freshness that arises from unlocking stifling thought-patterns. On the other hand, rebellion against them isn't necessarily a bad thing either.

3. Myth: Creativity Comes From the Unconscious — True and False
This notion originated during the Romantic Movement and was further elaborated by Freudian psychoanalysis. The idea is that creativity is directly linked to every individual's unconscious. It has connotations to ancient belief in divine madness, that individuals are the passive creators inspired and possessed by a muse[18].

In fact, research has shown that creativity has both an unconscious side and a highly conscious one and that both together form a hard working process[19]. The most successful innovators tend to be the most productive, in that they are able to prepare their unconscious to work on 'incubating' problems, before solutions appear in the conscious in a moment of insight, to be evaluated and elaborated on further.[20] Practice makes perfect and it takes many experiments to come up with one good solution.

4. Myth: Children Are More Creative Than Adults — True and False
In the Romantic era children were thought to be more creative because they were perceived to be closer to nature and the fantasy world and had not been corrupted by education systems and society's conformity[21]. The jury is out on this as there is evidence emerging that many education systems indeed seem to be designed to knock the creativity out of people, and that adults have 'learned' that their early creative impulses are not going to be of use to them in life[22]. In an ideal scenario education and society have the capacity to stimulate the creative process through providing stimuli, fueling creativity in children and adults alike.

5. Myth: Creative people are "liberated", free-spirited, and child-like! — False
The 'liberation' myth is based on the notion that freeing up people from their inhibitions, and encouraging them to be playful and childlike will unleash their creative fiber. Obviously, a person who is tied up with a rope can't play the violin. Yet, untying the rope won't make her a violinist. Comparing adult creativity

17 Edward De Bono, Lateral Thinking: Creativity Step by Step, Harper & Row, New York, 1973.
18 Sawyer, Explaining Creativity, p. 18.
19 Guy Claxton, *Hare Brain, Tortoise Mind*, Fourth Estate, London, 1997.
20 Mihaly Csíkszentmihályi, Creativity : Flow, Harper Perennial, New York, 1996.
21 Sawyer, Explaining Creativity, p. 19.
22 Guy Claxton, What's the Point of School, One World Publications, Oxford, 2008.
23 Sawyer, Explaining Creativity, p. 20.

with the playfulness of children is difficult. Children are endowed with a *creativity of innocence* because their minds have not yet formed as many stifling patterns. The minds of adults, by contrast, are filled with many taken-as-useful patterns to be cracked for the purpose of innovation! Just mimicking a child won't help grown-ups crack those patterns, but greater familiarity with their own creativity, creative tools and creative processes can.

6. Myth: Creativity Represents the Innate Spirit of the Individual — False
Prior to the Renaissance artists were considered craftspeople not visionaries, whereas the renaissance introduced the idea of artists' unique expression being fueled by their inner force. Creativity doesn't happen in isolation any more than it is innate — it relies on both individual input and reflection as well as inspiration from peers, society and contemporary culture. The group surrounding the individual has a huge influence in inspiring creative expression, whether recognised or not[23].

7. Myth: Creativity Is a Form of Therapeutic Self-discovery — True but..
The self-exploratory New Age conception of creativity is also influenced by the ancient idea of divine truth. In other words engaging in creativity equals a spiritual journey, the outcome of which is a personal transformation and enlightenment. Research suggests that creativity indeed does possess therapeutic elements, examples include music and art therapy. Being in 'Flow' or performing at one's peak as identified by Csikszentmihalyi (1997) is both conscious hard work as well as highly engaging, and it can - indirectly - be therapeutical.

8. Myth: Creativity Is Spontaneous Inspiration — False
The romantic notion that artists' creativity derives from rejection of tradition and convention - being isolated and not influenced by their social environment is still dominant in today's society. Ironically, most renowned artists these days all have a formal background studying the conventions and traditions of art. The formal training, while not needed, is useful in that it enables artists to grasp the existing principles behind art. This knowledge ensures that they consciously explore their creativity and define their own artistic expression[24].

9. Myth: Tools and techniques are confining! — False
The "tools as confining" myth rests on the notion that systematic tool-use is contrary to the nature of creativity, which must be "free." According to this view, materials should be malleable (like clay!), and user-friendly (like clay :). Contrary to belief, however, materials with an integrity [a "logic" of their own] are often more useful in boosting a maker's creativity —provided, of course, the maker invests the time and applies the discipline required to become a fluent user of that tool![25]

10. Creativity lives in the right brain hemisphere — False
Despite this popular belief there is no scientific evidence for this widely held notion. No one has ever found a specific brain location for creativity. Instead some differences have been found depending on whether people have formal training in the

24 Sawyer, Explaining Creativity, p. 21.
25 Boden, *The Creative Mind*, p. 65.

creative domain they are engaging in or not - those who have *no* formal training carry out the task primarily in their right hemispheres, whereas those with formal training use both hemispheres equally. *In fact, more recent research has shown that almost all activity involves interactions across the whole brain*.

11. Creativity is about divergent thinking — False
Some researchers have suggested that convergent thinking is a left-brain strength, with divergent thinking in the right brain[26]. And because for decades creativity was associated with divergent thinking (although we now know that's not accurate) this may have contributed to the myth about the predominance of right brain activity among creatives.

Brain research has found that brain damage usually reduces or completely terminates creative expression. This is probably because creativity requires a *constant dialogue between the hemispheres*; for example the imagery and symbols generated by the right hemisphere require the left hemisphere to translate them into creative verbalizations. Thus, researchers have hypothesized that *creative people have enriched communication* between their hemispheres[27].

12. Creativity is something you are born with — False
Creativity is not a single ability, or talent, any more than intelligence is. Nor is it confined to a chosen few, for we all share some degree of creative power, which is grounded in our ordinary human abilities.

To be sure, creativity demands expert knowledge of one type or another – and the more impressive the creativity, the more expert knowledge is involved. Often, the expertise involves a set of technical practices (piano-playing, designing and running experiments) which require not only years of effort but also often very expensive equipment.

Creativity also requires the skilled, and typically unconscious deployment of a large number of everyday psychological abilities, such as noticing, remembering, seeing, speaking, hearing, understanding language, recognising analogies. Each of these abilities involves subtle interpretative processes and complex mental structures. Yet, if one does not know the rules (not even tacitly), one can neither break them or bend them. Or rather, one cannot do so in a systematic way[28].

"Creativity requires a constant dialogue between the hemispheres... and researchers have hypothetisized that creative people have enriched communication between their hemispheres"

26 Sally P. Springer and Georg Deutsch, *Left Brain, Right Brain*, W. H. Freeman and Company, New York, 1981.
27 Sawyer Explaining Creativity, p. 45.
28 Boden, *The Creative Mind*, p. 261.

"Creativity is much like intelligence in that it consists of a number of skills and abilities intertwined, and is therefore similarly something that can be learned and mastered, not merely innate or fixed"

Mindsets and creativity

Carol Dweck's research on the role of mind-sets in the perception of intelligence, strongly suggests that people's beliefs about why they have failed have a disproportionately large impact on subsequent behaviour and motivation to seek further challenges.

Dweck[29] developed a broader theory of what separates the two general classes of learners—helpless versus mastery-oriented. She realised that these different types of individuals not only explain their failures differently, but they also hold different "theories" of intelligence. The helpless ones believe that intelligence is a fixed trait: you have only a certain amount, and that's that. Dweck calls this a "fixed mind-set." Mistakes crack people's self-confidence because they attribute errors to a lack of ability, which they feel powerless to change. They avoid challenges because challenges make mistakes more likely and looking smart less so. Such individuals shun effort in the belief that having to work hard means they are dumb.

The mastery-oriented individuals, by contrast, think that intelligence is malleable and can be developed through education and hard work. They want to learn above all else. After all, if you believe that you can expand your intellectual skills, you want to do just that. Because slip-ups stem from a lack of effort, not ability, they can be remedied by more effort. Challenges are energizing rather than intimidating; they offer opportunities to learn.

Students with such a growth mind-set, Dweck predicted and later proved, were destined for greater academic success and were quite likely to outperform their counterparts.

Creativity is much like intelligence in that it consists of a number of skills and abilities intertwined, and is therefore similarly something that can be learned and mastered, not merely innate or fixed.

A couple of studies illustrate these points about mindsets and expectations. In one classic study, in a mixed-ability classroom, Dweck gave each student a booklet containing maths problems. In some of the booklets, there was a middle section of problems which

29 Carol Dweck, *Mindset: The New Psychology of Success*, Random House, New York, 2006.

were too difficult for any of the students to be able to do. Dweck found that those students who had faced the 'impossible' questions then did badly at the normal problems later in the booklet, which they would otherwise have been able to do. The group hit hardest by the experience of being 'stumped' were the high-achieving — yet — "fixed mindset" girls, who were used to doing well and became 'helpless' when faced with what appeared to be the ceiling of their intelligence[30].

An experiment by Ellen Langer at Harvard University found that when students were told that an activity was 'play', they worked harder at it. When exactly the same task was described as 'work', they put in less effort, did not enjoy it as much, and gave up sooner[31]. Their expectations about the nature of 'work', and their own ability to do it, had a significant impact on their experience.

As Chapter 5 will show, if the students in these two studies had better-developed 'learning muscles', their experience would not have been so affected by these minor twists.

The Creative Process

Contrary to belief, no creative innovation emerges out of a single burst of genius or inspiration but requires a process of systematic refinement that evolves over time, and through hard work. Think of the time it takes to write a paper or to build a sandcastle, and of the preparation it takes to become a decent pianist, basket-player or chef!

Being creative requires intrinsic motivation, sustained engagement, and a willingness to pursue one' s ideas – and explorations – while at the same time, being open to change and look at the world afresh, differently, from varying perspectives. Creativity, like intelligence itself, is an adaptive process by which players transform the world and are, in turn, transformed through their action in the world;

As soon as an idea takes shape, it becomes at once tangible and shareable. Human creations, as a result, are by necessity social. Even solo creators never work alone: they too borrow and address their work. They too share and trade their ideas and creations with others. What's more, most children are not solo creators: they enjoy to play with others in the first palce —on-line or face to face!

Five phases of creativity

Mihaly Csikszentmihalyi was the first to break down the creative process into five distinctive phases, or steps, These steps are now widely recognized among creativity researchers.[32] They include:

1. **Preparation**: becoming immersed in problematic issues that are interesting and arouses curiosity.
2. **Incubation**: ideas churn around below the threshold of consciousness.
3. **Insight,** or illumination: the "Aha!" moment when a puzzle starts to fall together.
4. **Evaluation,** or verification: deciding if the insight is valuable and worth pursuing.
5. **Elaboration:** translating the insight into its final work[33]

Csikszentmihalyi also made it clear, from the outset, that human creativity is not a linear process. Instead, it is a recursive journey that leads a person to cycle through a series of

30 Claxton, What's the Point of School? pp. 20-21.

31 Claxton, What's the Point of School? p. 152.

32 Sawyer, *Explaining Creativity.*

steps, or milestones, at variable rates. In his words: "Incubation may last for years; sometimes it takes a few hours. Sometimes the creative idea includes one deep insight, and innumerable small ones." Let us now examine each phase in greater detail:

1. Preparation

"Our mind is not likely to give us a clear answer to any particular problem unless we set it a clear question, and we are more likely to notice the significance of any new piece of evidence, or new association of ideas, if we have formed a definite conception of a case to be proved or disproved" (David Goldberg, 2007[34])

Preparation refers to the base of experience and knowledge that precedes any creative journey. As Csikszentmihalyi put it: "during preparation, one becomes immersed—and develops a sensitivity to—the issues and problems in a field of interest.[35]

During this phase, creators are 'getting ready' to venture into unknown territory. Like travelers before departure, they undertake whatever is needed—in their eyes—to beat the odds, find the gems, and identify unbeaten paths to new desired destinations.

Here is how this works: creative individuals (or teams) gather the experience and knowledge required based on their interests and curiosity. With interest and curiosity comes a desire to know more. This in turn drives a person's inquisitive mind, and sets the stage to asking new questions, imagining new venues, and pursuing new paths.

2. Incubation

"We do not voluntarily or consciously think on a particular problem. Instead, a series of unconscious and un-voluntary mental events take place during that period"

Incubation involves "mulling things over" without even noticing it! In Csikszentmihalyi's words, "during this phase ideas churn around below the threshold of consciousness".[36] Because incubation involves the tossing around of ideas in an un-directed, un-conscious, and unstructured fashion, it ironically sets the stage for new unexpected combinations to emerge, usually at a later stage.

"Sometimes the creative idea includes one deep insight, and innumerable small ones"
- Mihaly Csikszentmihalyi

33 Csikszentmihalyi, *Flow*, p. 79.
34 http://www.slideshare.net/deg511/what-is-creativity-55929/ (slide 11)
35 Csikszentmihalyi, *Flow*, p. 79.
36 Csikszentmihalyi, *Flow*, p. 79.

While essential to creative outcomes, incubation is not always perceived as a productive moment by the creator, who don't quite see yet that something is cooking in the background….

There is now experimental evidence that corroborates vivid anecdotes from Poincaré and others, on just how incubation works. Steven Smith et al at Texas A&M University suggest that the delay provided by incubation allows time for un-fruitful quests and blind alleys to be forgotten, so that when you come back to the task you do so with a more open mind. There is a tendency to get fixated on a particular approach, even when its patently not working. The delay increases the chances that your mind will stop barking up the wrong tree[37].

To Csikszentmihalyi, incubation is a temporal process that may last for days, months or years, or work over such short spans as a few minutes.

3. Insight

Insight refers to the proverbial "light bulb" or "aha" experience that occurs when an idea suddenly bursts into consciousness. Wallas (1926)[38] initially referred to this moment as "illumination," and suggested that it is the point at which the whole answer or core solution to a problem springs into awareness suddenly and spontaneously.

While it is a break-through, the "aha" experience (also called Eureka! moment) is not necessarily one that pushes the process forward to the next stage (evaluation). More often than not, insights feed back to the incubation and preparation stages for further consideration, i.e., thinking about an idea unconsciously and drawing on past experience to understand it.

The moment of insight usually occurs when we are overcome by the kinds of surprises Margaret Boden talks about when distinguishing between different kinds of creativity, i.e combination, exploration or transformation. We are overcome by surprise, and in the following phases of evaluation, we begin determining if we like the look of the idea.

4. Evaluation

During this phase of the creative process, insights are contemplated, and analyzed for their viability. "This aspect of creativity may be the most challenging because it requires the creative person to be brutally honest about the prospects for his/her new insight".[39] Wallas (1926) termed this stage "verification" since it involves research into whether a concept is workable, whether the creator has the skills necessary to accomplish it, and whether it is truly novel enough to pursue.

Often, the results of this analysis feed back to the incubation and preparation phases for more earnest consideration, both in terms of consciously learning more about the matter (preparation), and unconsciously contemplating issues that might make the insight more viable (incubation).

5. Elaboration

or the crafting of the final outcome. "This aspect of creativity is the most laborious and time consuming part of the creative process".[40]

Elaboration is the phase when creative insights is actualized, that is, put into a form that is ready for final presentation. The idea

37 Claxton, Hare Brain, Tortoise Mind, p. 61.

38 Before Csikszentmihalyi, Wallas (1929) proposed an earlier 4-step model of the creative process that Csikszentmihalyi expanded and built upon.

39 Csikszentmihalyi, *Flow.*

40 Csikszentmihalyi, *Flow.*

of elaboration was not part of Wallas' (1926) original model of the creative process, which ended after evaluation/verification. Subsequent uses of Wallas's framework, however, often included some version of it.

Csikszentmihalyi argues that elaboration is generally the most difficult and time consuming part of the creative process. Kao uses the term "exploitation" rather than elaboration to express, in the context of entrepreneurial creativity, the importance of "capturing value from the creative act".[41]

Discussion of the model

Csikszentmihalyi 5-step model has been criticized for being too linear, sequential, and single-threaded, thus brushing over the recursive, multi-threaded or systemic, and not always time sensitive nature of human creativity.

Indeed, creative processes are complex, non linear, and they don't always progress in smoothly incremental ways. More important, creative individuals are rarely engaged in a single research thread or following a single train of thought. Instead, they are 'multi-tasking'. Any creative innovation, whether artictic or scientific is "a loosely connected network of enterprises"[42], As such, it usually progressing un-evenly. while one thread sleeps on the back-burner, others may pop into consciousness

In all fairness, however, Csikszentmihalyi has always been quite explicit in characterizing human creativity as a recursive process of intertwined feedback loops and iterations (especially in terms of how insights are refreshed and updated by ongoing processes of incubation and evaluation). The five steps, to him, are meant as key moments (thresholds) that creators move through before a set of idea comes to fruition, and can be expressed / shaped /materialized / embodied in a form understandable by others.

"Creative individuals are rarely engaged in a single research thread or following a single train of thought. Instead they are 'multi-tasking'. Any creative innovation, whether artistic or scientific is a loosely connected network of en-terprises"

41 Kao, 1989, p.17.

42 Howard e. Gruber and K. Bodeker (eds.), *Creativity, Psychology and the History of Science*, Springer, 2005.

Flow – the balance of challenge and ability

In addition to documenting the 5 steps of the creative process, Csikszentmihalyi's other major contribution to our understanding of creativity and creative expression is through his theory of Flow, or the balance of challenge and ability and how this delicate balance can give rise to peak experiences or as he calls it, the Flow state.

Csikszentmihalyi's flow theory brings into focus the relationship between the creative process and one's mindsets, highlighting the conditions for flow as the following[43]:

1. *Clear goals* (expectations and rules are discernible and goals are attainable and align appropriately with one's skill set and abilities).
2. *Concentrating and focusing*, a high degree of concentration on a limited field of attention (a person engaged in the activity will have the opportunity to focus and to delve deeply into it).
3. A *loss of the feeling of* *self-consciousness*, the merging of action and awareness.
4. *Distorted sense of time*, one's subjective experience of time is altered.
5. Direct and immediate *feedback* (successes and failures in the course of the activity are apparent, so that behavior can be adjusted as needed).
6. *Balance between ability level and challenge* (the activity is neither too easy nor too difficult).
7. A sense of personal *control* over the situation or activity.
8. The activity is *intrinsically rewarding*, so there is an effortlessness of action.
9. People become absorbed in their activity, and focus of awareness is narrowed down to the activity itself, *action awareness merging*.

Not all are needed for flow to be experienced.

43 Mihaly Csíkszentmihályi, *Flow: The Psychology of Optimal Experience*, Harper and Row, New York, 1990.

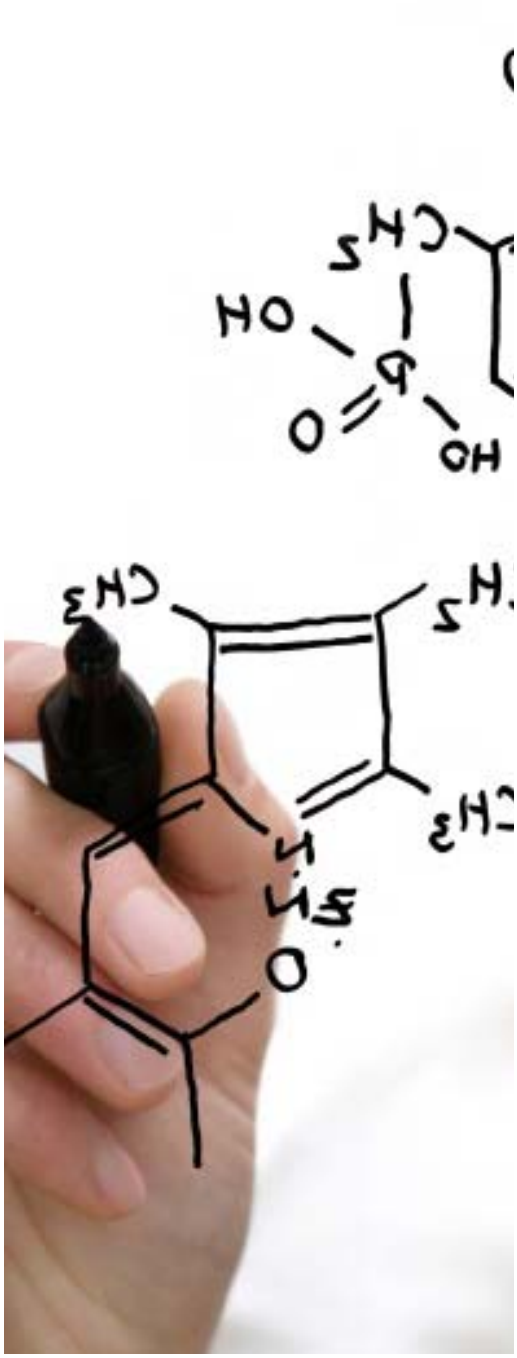
Czikszentmihalyi further notes that motivation plays an essential role in creativity. The most creative people are those who are intrinsically motivated – they are so motivated by their work that they often find themselves losing track of time. They focus in on what they are doing, forget about everyday problems and are oblivious to distractions in their environment. For creative people, these are the peak experiences of their lives.

"The most creative people are those who are intrinsically motivated - they are so motivated by their work that they often find themselves losing track of time"

The study of peak experience began in the 1950s with the humanistic psychologists Carl Rogers (1954, 1961) and Abraham Maslow (1954). Csikszentmihalyi (1990b) continued this tradition of work with his studies of the flow state – the sensation of peak experience that people get from pursuing the challenge associated with cutting-edge creative pursuits.

Sawyer references decades of creativity research showing that external rewards can easily short-circuit the benefits of the flow state. When subjects are told that they are going to be externally evaluated or rewarded for creative work, their level of creativity (and their intrinsic motivation) declines. Creativity comes from intrinsic motivation, and externally motivating factors actively interfere with creativity.

2



Chapter 2

What are systems and what is their role in creativity and learning?

What are systems and what is their role in creativity and learning?

2

System — 1. An assemblage or combination of things or parts forming a complex, or unitary whole: *a mountain system, a railroad system*. 2. any assemblage or set of correlated members. 3. an ordered and comprehensive assemblage of facts, principles, methods etc. in a particular field; *a system of philosophy* 4. Any formulated, regular, or special method or plan of procedure[44]...

Creativity does not simply 'happen'. We know when we have encountered an instance of creativity because it comes to our attention in a particular perceivable form: as a beautiful section of music, a finely-crafted perfume, a delicious cake, a well-told joke, a scarf with an interesting texture, or an attractive sculpture. In any of these cases, we appreciate the way in which an individual (or group) has channelled their creative talents within the rules, norms and structures of a particular *system.* The system in this context refers to the constraints within a medium, the knowledge structures of a genre, and even the mental discipline involved in mastering the medium itself — that have to be collectively addressed in order to achieve the end result, which we deem as new, surprising and valuable.

Without systems, creativity has nowhere to go. In spite of the common lazy association of creativity with 'eccentric' people and 'crazy' behaviour, creativity is rarely expressed in a wholly messy or disordered way, except perhaps by toddlers. In this chapter we will see that only by channelling creativity through a system do we achieve meaningful results.

Principles of systems

Systems can be found as far afield as computer science, geology and theology, suggesting that systems are an intrisic companion not only to our individual need to structure our knowledge, but equally as a means for groups to collaborate.

Michael Pidwirny, a specialist in physical geography, has ventured a set of eight principles to define what constitutes a system, arguing that most systems share the same common characteristics. He lists the following features:[45]

1. Systems have a ***structure*** that is defined by its parts and processes.
2. Systems are ***generalizations*** of ***reality***
3. Systems tend to ***function*** in the same way. This involves the **inputs** and **outputs** of ***material*** (***energy*** and/or ***matter***) that is then processed causing it to change in some way.
4. The various parts of a system have ***functional*** as well as ***structural relationships*** between each other.
5. The fact that functional relationships exist between the parts suggests the

44 *College Dictionary,* Random House, New York, 1992.

45 Michael Pidwirny, *Definitions of Systems and Models*, Fundamentals of Physical Geography, 2nd Edition, 2006, accessed 12/10/2008. http://www.physicalgeography.net/fundamentals/4b.html

flow and ***transfer*** of some type of ***energy*** and/or ***matter***.

6. Systems often exchange energy and/or matter beyond their defined boundary with the outside environment, and other systems, through various **input** and **output** processes.
7. Functional relationships can only occur because of the presence of a ***driving force***.
8. The parts that make up a system show some degree of integration - in other words the parts work well together.

These features of systems are discussed in relation to the LEGO® system in chapter 6.

In addition to all of these features, an important aspect of systems is that they typically add up to more than the sum of their parts. For example, the parts of the human brain working together can generate consciousness and creative thought. None of the individual parts, such as each nerve cell in the brain, can do this – indeed each part can seem relatively unspectacular in its own right. But when these parts are interacting in the right way, they can create thought, language, and ideas. These are *emergent properties* of the system[46]. To understand a system we can reduce it to its constituent parts, each of which plays a role in determining what the system can do, but to see the system perform fully we have to consider the system's properties which emerge from the properties of the parts and how they interact.

The three roles of systems in creativity and learning

Systems underpin creativity in three different ways:

1. from *a way of processing the world around us* and making sense of it,
2. to *generating new and more intricate understanding* of the world through creative exploration
3. to lastly, but not least, *expressing that understanding* through different creative systems, be it language, music etc.

1. Systems as a natural form of assimilating[47] and creating meaning

The instance on systems or structures can seem mechanistic, or even authoritarian. But the desire to apply systems or structures to things is typically a helpful form of organisation — bringing order, and clarifying meaning. When we say 'We need a system to deal with this' we mean that a task needs to be arranged and presented in 'mind-sized bits (not necessarily in stages) so that there is a transparent process which makes sense. Systems and structures can therefore *facilitate* the attainment of goals, and this is probably because the human mind uses systems to make sense of the world, and routinely creates structures of meaning, all the time.

Recent scientific research has shown that the human brain continuously applies a sorting system to deal with incoming data. Without this constant processing, the world as we perceive it would be, literally, 'too much information', a maelstrom of sights, sounds, textures, tastes and smells.

46 David Rose, Consciousness: Philosophical, Psychological and Neural Theories, Oxford University Press, Oxford, 2006, p. 20.

47 The notion of processing as adopted by cognitive scientists finds an equivalent in constructivist parlance, to the term assimilation, an organism's ability to use sensory inputs to drive its actions (filtering occurs) and, in turn, to look at the world in terms of its own constructed lens, filter, or interpretive framework, often referred to as 'knowledge structure'.

Neurobiologist and philosopher of science Gunther Stent explains that 'knowledge about the world of phenomena enters the mind not as raw data but in an already highly abstract form, namely as *structures*.

In the process of converting the primary sensory data, step by step, into structures, information is necessarily lost because the creation of structures, or the recognition of patterns, is nothing other than the selective destruction of information'.[48] The structures produced by this system are therefore necessary in order to make meaning out of a complex world. The apparent negative point here is that a mass of rich sensory data is disposed of and ignored. But, more positively, this systematic application of structure or filtering, is *necessary*, so that we can deal with our environment efficiently.

As well as sifting out unnecessary data and bringing order to our perceptions, the brain knits together all dimensions of experience into a single 'piece'. Experience is continuously and systematically structured to provide us with one complete (but ever-changing) sense of what's going on. As the neuroscientist Gerald Edelman observes, we apprehend the world, in each moment, as a 'unitary scene', although the scene may change continuously as we receive new stimuli or have new thoughts.

> The number of such differentiated scenes seems endless, yet each is unitary. The scene… can contain many disparate elements – sensations, perceptions, images, memories, thoughts, emotions, aches, pains, vague feelings, and so on. Looked at from the inside, consciousness seems continually to change, yet at each moment is all of a piece – what I have called 'the remembered present' – reflecting the fact that all my past experience is engaged in forming my integrated awareness of this single moment[49].

The human brain is able to apply and combine structures so that the 'many disparate elements' of experience become unified and meaningful. At the same time, if we start off working with simple and meaningful systems, it is perhaps the case that the primary sense-making task becomes lighter, and frees up some brain power for deeper thinking.

2. Systems as a method for expanding our understanding of the world

David Bohm, regarded as one of the greatest physicists of the twentieth century, suggested that human creative activity – whether in the sciences, the arts, or other spheres – is motivated by a need to make sense of the world and to give form to those understandings. 'Man has a fundamental need to assimilate all his experience, both of the external environment and of his internal psychological process,' he wrote, even adding that 'failing to do so is like not properly digesting food,' leading to 'disharmony and conflict'.[50]

Yet, beyond purely a need to assimilate and categorise vast quantities in mental systems, which allows us to access them again with ease, the second role of systems is in how we systematically expand and grow our understanding of the world.

As Margaret Boden suggests, the second form of creativity, *explorative creativity*, is immensely important in our ability to expand our understanding of an area as we come up with new ideas we hold up to the area we are exploring to see if it 'fits' and if it does, our understanding of that domain has grown,

48 Gunther Stent, "Meaning in Art and Science," in *The Origins of Creativity,* eds. Karl H. Pfenninger and Valerie R. Shubik, Oxford University Press, Oxford, 2001, p. 36.

49 Gerald M. Edelman, *Wider than the Sky: The Phenomenal Gift of Consciousness*, Yale University Press, 2005, p. 8.

50 David Bohm and Lee Nichol, *On Creativity*, Routledge, New York, 1998, p. 27.

leading to potentially more ideas and even greater understanding.

Having opportunities to be creative, then, is not a pleasant luxury for the lucky few. On the contrary, a healthy society needs to breathe creativity. Creative exploration helps us to understand our place in the world: Bohm suggests that science is a desire to understand the universe, and to feel 'at home' in it, and making art can similarly be seen as a way of thinking-through our relationship to lived existence. Bohm adds that science, art and religion all look for a kind of *beauty*. We might conclude, then, that creative exploration may be driven by a drive for assimilation, beauty and wholeness. This is seen by Bohm as essential to human progress:

> Creativity is essential not only for science, but for the whole of life. If you get stuck in a mechanical repetitious order, then you will degenerate. That is one of the problems that has grounded every civilisation: a certain repetition.[51]

If we accept that human beings start off in life with creative *potential*, then it follows that in the early years a healthy society will nurture creativity and curiosity, and then will give both young people and adults *opportunities* and *channels* for their creativity.

It is in this sense that some kind of system can be seen as a *prerequisite* for meaningful creativity. It is not common for someone to announce, 'I will be creative now,' and then sit down to simply 'be creative' within their mind. Creativity is more usually an interaction between the internal and external worlds, and involves manipulation of certain tools or equipment. For creativity to happen in the world, we typically make use of pens, a whiteboard, a piano, paint, a welding kit, LEGO® bricks, or whatever resources are appropriate.

3. Systems as a means to channel creative expression and learning

Discussions of creativity are often centred around artistic examples. When thinking of historical creativity (H-creativity), we tend to cite Picasso, Shakespeare, and Mozart, and when discussing everyday creativity (P-creativity) we mention drawing, photography, or poetry. It can be forgotten that creativity, on either level, is also the domain of engineers, scientists, managers, activists and sportspeople. In any of these fields, creativity might be expressed by working within existing systems, or by overturning the system entirely.

Gunther Stent argues that art and science are fundamentally similar, as they both 'seek to discover and communicate novel truths about the world' (2001: 35). He notes that we tend to judge science on the ideas or discoveries involved, whereas in art it is the *form* of their communication which preoccupies us. So we admire Watson and Crick's paper revealing the structure of DNA because of this discovery itself, not because of how it was actually *written up*; whereas we admire Shakespeare's plays because of the way he has rendered the material in words, but not for the stories themselves, which were often not original and were borrowed from various sources[52]

Thomas Cech[53], however, responds to this by pointing out that scientists and artists have quite different intentions. A number of scientists working on the same problem are striving towards the same goal – they want to reach the one 'perfect' explanation, which

51 Bohm, *On Creativity,* p. 108.

52 Stent, The Origins of Creativity, p. 34.

53 Thomas Cech, "Overturning the Dogma: Catalytic RNA" in *The Origins of Creativity,* ed. Karl H. Pfenninger and Valerie R. Shubik, Oxford University Press, Oxford, 2001.

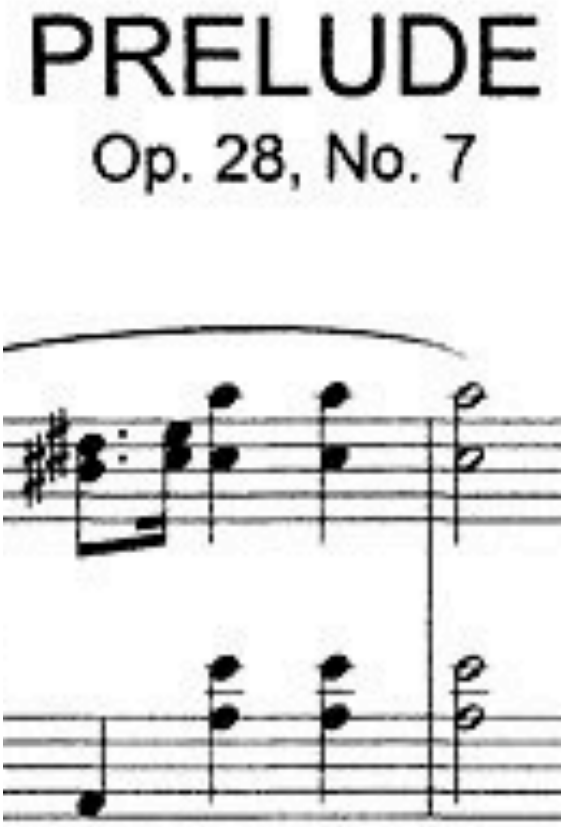
the field (the audience of scientists and other interested parties) will agree is the correct one. Whereas a number of artists working on the same 'problem' – which in this case might be, say, the nature of identity or memory – will expect to produce strikingly *different* 'answers' to this issue and would be embarrassed if their proposition was very similar to someone else's.

Therefore the systems of science channel creativity in particular directions, towards specific questions; whereas the systems of art forms, such as music or oil painting, offer more of an 'open palette' to the creative individual. The LEGO System has something in common with both of these: it can offer the tools through which a problem can be solved (how to transport an apple from A to B, or how to bridge a stream), or can offer a palette of opportunity for open creative expression (building a fantasy creature, spaceship or landscape; or, as in LEGO® Serious Play, creating metaphors to represent feelings or identities).

Both types, as Stent noted, are about making inventive propositions, and trying to say something new about the world. Attempting to appeal to both artistic and scientific communities, the painter Françoise Gilot says that the work of artists is 'a kind of mediation between the individual, nature and society… through which we can find an order that will enrich the imagination and lead to new, more complex truths'.[54] She implies that scientists and engineers share a similar motive.

"Systems of science channel creativity in particular directions, towards specific questions; whereas the systems of art forms, such as music or oil painting, offer a more open palette to the individual"

54 Françoise Gilot, "A Painter's Perspective", in *The Origins of Creativity,* ed. Karl H. Pfenninger and Valerie R. Shubik, Oxford University Press, Oxford, 2001.



[This is a public-domain image of Frederic Chopin's *Prelude* op. 28, no. 7, from http://en.wikipedia.org/wiki/Image:Chopin–Prelude–No.–7.JPG]

Examples of other creative systems and their properties

Music

Music is a form of artistic expression and creativity which clearly takes place within a system: with the exception of a (proportionately very small) number of avant-garde pieces and some electronica, Western music can be represented in the clear system of musical notation, which is familiar to us:

Although all young children can create the random 'music' of bangs and shrieks, the example of music underlines how a creative system has elements that need to be learned and mastered. As Ken Robinson says,

> I can't play the piano. I don't mean I'm incapable of playing it. I don't know how. To that extent, I can't realise its creative potential. I can make noises on it and be expressive but I can't be as creative as those who can really play it. Creative achievement is related to control of the medium. Simply asking people to be creative is not enough[55]..

People come to master music by developing familiarity with its broad expressive potential, on the one hand, and the particular constraints of how it is produced, performed, written and recorded, on the other.

Composers are traditionally faced with a standard set of tools – the orchestra – through which to channel their creativity. (Modern music is full of exceptions to this, of course, but even that is more often than not delivered through bass – drums – guitar – keyboards, or a particular set of electronic software tools). This is rarely seen as a handicap. Although one can imagine an alternate reality where the idea that most pieces of music could be played by more-or-less the same orchestra set-up would seem ridiculous, this is not the case in reality.

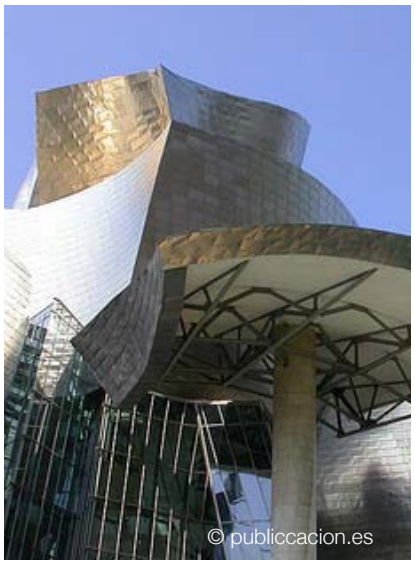
55 Ken Robinson, *Out of Our Minds: Learning to be Creative*, Capstone, Chichester, 2001, p.131.

Instead, the systems that music is positioned within – the score, the orchestra or band, the typical lengths of different types of songs and pieces – are experienced as *enabling*. Classical, modern and pop music all have their conventions, but these are rarely fought against – and such oppositional moves are usually failures – because the systems are embraced by both the creators and the audience. Just as within the LEGO® System, where experienced builders may be disgusted by the 'cheating' when a construction problem has been solved by use of a non-LEGO element, the system of music is resistant to non-system elements except in special circumstances. (For example, the use of synthesisers alongside orchestra is accepted by aficionados of film music, but is seen as inappropriate and unnecessary by more classical purists).

Architecture

Both classical music and the LEGO System are systems which come with a kit of parts (the orchestra, the LEGO bricks), and with a particular 'language' for its expression (musical notation, LEGO models or diagrams). Architecture has in common with music a history of previous instances going back hundreds of years, but is a somewhat looser system. The materials are not fixed in advance, but can be chosen by the architect (although, in real-world building, the range may be limited), and a building design can look like 'anything' (although again, real-world constraints and expectations will impinge). The architect therefore has to find a balance between the possibilities of the imagination, and the real-world constraints of materials, cost, and practical functionality. On the one hand, the aspirational architect wants a building that will look original and stunning; at the same time, the building should be an enjoyable and straightforward place to live, work, and move around in. These are the boundaries of the system that the architect works within.

Creativity can be channelled through this system in various ways. The most audaciously 'creative' buildings, in outward appearance, may be relatively conventional underneath, whilst more subtle visual designs may conceal creative innovations in other ways. For example,



Frank Gehry's buildings such as Guggenheim Museum Bilbao are beautiful to look at, but have been criticised for having a showy exterior frame placed upon an inner shell which does not match the exterior shape in the traditional (and arguably most useful) style. Gehry's buildings also show the application of tools, such as use of CATIA (Computer Aided Three Dimensional Interactive Application) and computer visualizations, which were not previously available within the system.

Conversely, the work of Nicholas Grimshaw, such as Waterloo International railway station (London's Eurostar terminal, 1994–2007), is appreciated for its thoughtfully designed approach to moving people through a space, sensible use of surfaces and materials, and so on, but is usually not considered a great visual spectacle. (Other Grimshaw projects, such as the Eden Project, feature more of a fusion between functional design and visual aesthetics). Therefore the architect has again channeled their creativity through the system, but with different key goals.

As with any system, the signature of the creator can be seen in their products: a building by Frank Gehry embodies the unmistakeable spirit of the creator, just as a piano concerto by Clara Schumann bears the unique imprint of the composer, and a paragraph by Kurt Vonnegut is unlike a paragraph by any other writer.

Language as the most basic creative system

An even more common creative system is, of course, language. Linguists of all kinds agree that words are both a routine and yet incredibly rich resource. Noam Chomsky, for instance, writes about 'the prodigious "generative" power of a few essentially "deep" structures and their capacity to be "transformed" into myriad "surface" forms as virtually infinite realisations of basically finite resources'[56]. There is an obvious parallel with the LEGO® System, where a limited range of plastic pieces can be used to build a potentially infinite number of things.

Language has such rich creative potential that, ironically, it is difficult to account for all these possibilities in language. Chomsky observes that

56 Rob Pope, *Creativity: Theory, History, Practice*, Routledge, London, 2005, p. 55.

language operates and can be put together in ways that come more-or-less easily to us as human beings, but which are extraordinarily difficult to describe and document – 'the most comprehensive grammars and dictionaries – *Oxford English Dictionary*, ten-volume grammar of English and so on – [are merely] skimming the surface'[57]. Again, this has a parallel in the LEGO System, hinted at in the much-quoted fact that six 2 x 4 LEGO bricks of the same colour can be combined in over 915 million ways. Putting LEGO bricks together with the hands, in diverse and appealing combinations, is easy, but documenting all the potentials and limits of the system would be an almost impossible task. The fact that we can *do* it much more easily than we could *describe* it indicates that the brain takes to the 'language' of LEGO® construction through natural inclination, picking up its possibilities through intuition rather than instruction – which is just how language is learned.

As Chomsky observed, children are able to work creatively with language in ways which far exceed the models offered to them in the specific *things that are said to them* by their parents. In the same way, a child may observe some building principles when her father makes a LEGO rocket, but she does not have to make her own spaceship the same, and can often do it better. This appears to be much the same as what Steven Pinker has called 'the language instinct' – 'a complex, specialised skill, which develops in the child spontaneously, without conscious effort or formal instruction, [and] is deployed without awareness of its underlying logic'[58].

Pinker suggests, like Chomsky, that our ability to creatively work with the system of language to create meaningful speech is a unique and distinctive human ability. Pinker argues that it is the combination of words and rules that enable language to be so incredibly expressive[59] – we creatively deal with both the component materials (the words) and the possible ways in which they can be put together (the rules) in order to produce expressions which have potentially never been produced before. Again, this clearly maps easily onto the LEGO System, where a builder has to select specific pieces in particular colours (akin to words), and then use the studs and tubes of LEGO assembly (the rules), to realize their creation.

Language is also a key component of identity, with the curious detail that regional or dialect variations *within* a language can be more rich and meaningful, in identity terms, than the rather starker difference we find when I only speak Russian and you only speak French. Dialects have some similarities to the different LEGO themes and styles. Although all part of the same language, the characteristics of things made within the Bionicle theme are somewhat foreign to those who are most at home with LEGO City, and that style is clearly different to that of someone whose identity is most associated with Technic building. Those who build on the Miniland scale are speaking a very different dialect to those who prefer Belville. Once we have learned a particular 'LEGO dialect', there can be transition from one to another, but it is common for an individual to identify with a particular way of 'speaking' LEGO and be relatively less comfortable with the other ways[60].

57 Noam Chomsky, *The Architecture of Language*, Oxford University Press, Oxford, 2000, p. 12.

58 Steven Pinker, *The Language Instinct*, William Morrow, New York, 1994, p. 18.

59 Steven Pinker, *Words and Rules: The Ingredients of Language*, Weidenfeld and Nicholson, London, 1999.

60 This is all speculation! 'More research needed', as they say.

Creativity itself as a system of social reflection

On a broader scale, moving away from the discussion of any one particular creative system, we can see creativity itself as humanity's system for reflecting upon itself. We have already seen that David Bohm argued that creativity was an essential aspect of human activity, an absence of which would lead to stagnation and entropy.

Earlier in the twentieth century, John Dewey argued that looking at or experiencing creative works – or at least, those that are meaningful to us – 'elicits and accentuates' the experience of wholeness and connection with the wider universe beyond ourselves.[61] Dewey does not mean famous 'master-pieces' in particular – although those works are likely to have become celebrated because they were powerful prompts for those kinds of feelings. But for Dewey, art is part of everyday experience. 'The understanding of art and of its role in civilization is not furthered by setting out with eulogies of it nor by occupying ourselves exclusively at the outset with great works of art recognized as such'.[62]

Dewey suggests that understanding an artistic experience is like understanding how a flower grows – rather than simply noticing that it is pretty – and therefore involves an understanding of 'the soil, air, and light' which have contributed to the etiology of the work and which will be reflected in it.[63]

Furthermore, Dewey suggests that art can introduce us 'into a world beyond this world which is nevertheless the deeper reality of the world in which we live in our ordinary experiences.' This may sound rather spiritual, but Dewey's concerns are pragmatic: 'I can see no psychological ground for such properties of an experience, save that, somehow, the work of art operates to deepen and to raise to great clarity that sense of an enveloping undefined whole that accompanies every normal experience'. This brings 'a peculiarly satisfying sense of unity in itself and with ourselves'.[64]

Therefore, simply put, making or looking at a work of art encourages reflection upon ourselves and our place in the world, and this in turn is perhaps the basis for our cultural systems, and an argument for creativity in society.

Craftsmanship as part of a wholesome social system

Richard Sennett[65] discusses the idea of 'the craftsman'[66] – someone who is engaged in their creative work, and wants to do good work for its own sake. This he describes as "an enduring, basic human impulse"[67]. He notes that making things and thinking about things are often seen as separate activities, but suggests that in fact "thinking and feeling are contained within the process of making"[68] – as we often note about the LEGO® System, where building with the hands is part of the process of thinking-through the construction. Thinking with the hands is also part of a process through which we not only crack problems but also open up new avenues for exploration: 'The good craftsman uses solutions to uncover new territory; problem solving and problem finding are intimately related in his or her mind'[69].

Sennett argues that craftsmanship is founded on three basic abilities. These are the ability to localize, to question, and to

61 John Dewey, *Art as Experience,* Perigree, New York, 1980/2005, p. 195.
62 Dewey, Art as Experience, p. 10.
63 Dewey, Art as Experience, p.12
64 Dewey, Art as Experience, p. 195
65 Richard Sennett, *The Craftsman*, Penguin, London, 2008.
66 Sennett notes that the idea of a 'crafts*man*' may sound sexist, but he intends the term as a shorthand for a craftsperson who can, of course, be male or female.
67 Sennett, *The Craftsman,* p. 9.
68 Sennett, *The Craftsman,* p. 7.
69 Sennett, *The Craftsman*, p. 11.

open up. The first involves making a matter concrete, the second reflecting on its qualities, the third expanding its sense[70]. Localizing involves focus on a particular creative problem; questioning involves investigation and curiosity – a state of mind where the need to make decisions is suspended whilst the project is probed; and 'opening up' draws on intuitive leaps between domains of knowledge or experience.

In today's manufactured world, it is common to prefer things to be precisely made by machines, rather than put together by hand. Things we make may not be 'perfect', but their imperfections reveal our individuality and our *presence*. As Sennett says, 'Against the claim of perfection we can assert our own individuality, which gives distinctive character to the work we do'[71].

Surprisingly perhaps, Sennett ends up proposing that the human ability to create and construct provides the foundations of society itself:

> No one could deny that people are born or become unequal. But inequality is not the most important fact about human beings. Our species' ability to make things reveals more what we share. A political consequence follows from the facts of these shared talents... Learning to work well enables people to govern themselves and so become good citizens... Thomas Jefferson's democratic celebration of the American farmer-yeoman or skilled artisan stands on the same ground, the practical man being able to judge how well government is built because he understands building[72].

He suggests that the challenges of making things well are like the challenge and potential of making human relationships. 'The craft of making physical things provides insight into the the techniques of experience that can shape our dealings with others,' he argues[73], indicating that the pride taken in making something well connects with citizenship and the pleasure of trying to do things well in society. This connects back to the physical act of *making*, since 'who we are arises directly from what our bodies can do'[74].

Creating meaning and shaping the world through tools

In his 1973 book, *Tools for Conviviality*, the radical social thinker Ivan Illich set out his vision of how society needed tools which encouraged individual creativity, enabling people to give shape and character to their own lives, rather than those tools which tend to impose a mass sameness. For Illich, a 'tool' is anything used to produce some thing or effect, so it includes drills and brooms, cars and power stations, and even schools and hospitals. This broad use of the term enables him to pull together everything that is designed to do something, whether that is to dig a ditch or to create an 'educated' person. In the phrase 'tools for conviviality', the term 'conviviality' for Illich means 'autonomous and creative intercourse among persons … the opposite of industrial productivity'.[75]

This brings us to his vision of a preferable kind of society: "A convivial society should be designed to allow all its members the most

70 Sennett, *The Craftsman*, p. 277.
71 Sennett, *The Craftsman*, p. 105.
72 Sennett, *The Craftsman*, p. 269.
73 Sennett, *The Craftsman*, p. 289
74 Sennett, *The Craftsman*, p. 290
75 Ivan Illich, *Tools for Conviviality* (Harper & Row, New York, 1973, p. 11.

autonomous action by means of tools least controlled by others. People feel joy, as opposed to mere pleasure, to the extent that their activities are creative; while the growth of tools beyond a certain point increases regimentation, dependence, exploitation, and impotence."[76]

Therefore, convivial tools can be freely used, or not; do not require particular qualifications; and 'allow the user to express his meaning in action'.[77] It can be argued that, for instance, Web 2.0 services are (usually) convivial tools in Illich's terms[78], and it is clear that the LEGO® System could be said to fit this outline as well.

"Tools are intrinsic to social relationships. An individual relates himself in action to his society through the use of tools that he actively masters, or by which he is passively acted upon. To the degree that he masters his tools, he can invest the world with his meaning; to the degree that he is mastered by his tools, the shape of the tool determines his own self-image. Convivial tools are those which give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her vision. Industrial tools deny this possibility to those who use them and they allow their designers to determine the meaning and expectations of others."[79]

As we know, the LEGO System is all about giving people a tool to explore their world and to invest it with meaning. Illich's arguments speak powerfully to the LEGO ethos: giving people the tools to make what they want to make, not what others have made for them, and being able to make their own meanings for things, not be told what to think.

"Tools are intrinsic to social relationships...To the degree that he masters his tools, he can invest the world with his meaning.."

76 Illich, Tools for Conviviality, p. 20

77 Illich, Tools for Conviviality, p. 22

78 David Gauntlett, Media, Gender and Identity: An Introduction, Routledge, New York, 2008.

79 Illich, Tools for Conviviality, p. 21.

3

Chapter 3

What is the role of play in creativity and learning?

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3

The importance of curiosity and playfulness in human learning and development is generally recognized. We also know that curiosity, playfulness, imagination, creativity and learning entertain complex relations.

"There is evidence that children, from the youngest age, are capable of building upon their insatiable curiosity to develop logical and rational thought". (Pierre Lénat, Erasmus Lecture, Paris, 2005). In the realm of play and creativity, we can reformulate Lenat's statement as follows: There is strong evidence that children, from the youngest age, are capable of building upon their insatiable urge to play—natural playfulness— to develop their creative potential—from *intelligent form giving*, or design, to *lateral thinking*, or abilities to think out of the box.

According to Huizinga(1955)[80], an activity is playful if it is: 1. fully absorbing, 2. intrinsically motivated, 3. If it includes elements of uncertainty, or surprise, and 4. If it involves a sense of illusion or exaggeration. Huizinga emphasises that play occurs in a "space" that is distinct from [the constraints of] a person's everyday life. Following Huizinga, Susanna Millar (1968)[81] further points out that playfulness detaches messages, experiences, and objects from their context of origin, creating a new frame that allows for greater freedom, interactivity, and creative possibilities. To Millar, play is about "throwing off constraint" (1968, p. 21). As we play with the constraints of a situation [respecting and transgressing rules], we feel free to move, engage with new contexts as well as engage the context of our recent experience as an object of play.

Boden notes that a young child's ability to construct new conceptual spaces is seldom appreciated even by its doting parents. All human infants spontaneously transform their own conceptual space in fundamental ways, so that they come to be able to think thoughts of a kind which they could not have thought before. Their creative powers gradually increase, as they develop the ability to vary their behaviour in increasingly flexible ways, and even to reflect on what they are doing[82].

Curiosity and playfulness: the cornerstones of creative play

Ackermann puts it boldly: a person may be curious and not very playful, or playful and not very curious. Here is why: A dominance of *curiosity,* sets the stage for systematic inquiry, and is usually driven by an urge to discover, explain, and replicate "hidden" mechanisms—or principles—behind some intriguing or enchanting phenomenon.
Its purpose is to capture the reasons and causes behind the magic. Its role is to turn

80 Huizinga, J. (1955). Homo ludens: A study of the play-element in culture. Boston: Beacon Press.

81 Millar, S. (1968). The psychology of play. Penguin Books, Ltd

82 Boden, *The Creative Mind*, p. 76.

the unfamiliar into the familiar. A dominance of *play*, in contrast, sets the stage for breaking loose from habitual ways of thinking and doing, and is driven by a desire to imagine alternatives, generate variations, and fictionalize or dramatize, reality. Its goal is turning the familiar, the taken-for-granted, into the uncanny, the humorous, the incongruous.

In sum, while curiosity and playfulness both require a sense of be-wonderment followed by a person's mindful engagement and systematic exploration, each generates their own ways of unveiling what's behind the surface of things. Curious minds seek evidence, ask why questions, and offer causal explanations ("if then" statements).

Playful minds subvert "realities" into fantasy or fiction (a displaced reality to be experienced in surprising, delightful, and amusing ways), and asks what-if questions. When successful, both curious minds and playful spirits create and inspire, yet they do so in different ways, engaging different parts of a person's mind in an enriched dialogue, setting the stage for combinatorial, exploratory and transformational kinds of creativity to occur.

Children don't distinguish between types of play the ways most adults do, nor do they dissociate—or sequence—the *constructive*, *performative*, and *make-believe* aspects of play, while engaged in playing. Instead, children integrate different forms of play (they build, perform, and pretend) at each moment in the creative / constructive process. To the playing child, making things (build / create), making things up (imagine / fantasise) and making-believe (doing as-if / pretense) are all essential parts of the play experience. In a child's mind, that is, you don't first build and then play, or first imagine and then implement. To them, even playing the score, or building from instructions, can be fun as long as there is enough mental "elbow room" to wiggle and vary constraints.

Boden also mentions our fondness of testing the rules and bending them. We add constraints to see what happens then. We seek the imposed constraints, and try to overcome them by changing the rules. In short, nothing is more natural than 'playing around' with materials (and constraints) "at hand" to gauge the potential – and the limits – of a given way of thinking.

Playing around with materials and constraints, successfully or not, enables learners to break loose from their habitual ways of doing and thinking in order to make thoughts possible that were not possible before. To put it another way, nothing is more natural - and engaging - than cycling back and forth, and getting the dance going between 'how we thought things were', 'what the materials tell us', and how we can adjust (our thinking or the materials) to reduce the gap. Creative play teaches us the skills required to do just that.

Ingredients of creative play

At the heart of creative play is pretense, or suspension of disbelief, which itself is at the heart of human imagination, and imagination constitutes the inner face of creative expression. Said otherwise, the *make-believe* nature of play is its most distinctive feature when it comes to enabling youngsters to enact, re-visit, explore, and exchange otherwise risky ideas on secure grounds.

Role-play is a specific form of pretense "where the child assumes or is given a role to play" Through it, a person experiences things through the eyes of others, and learns to simultaneously stage, enact, narrate, and ultimately work through aspects of her own and other people's ways of being, doing, and relating. Role-play requires that the players mentally slip out of their personae, and act *as if* they were someone else: another person, animal, or even a thing that they animate in their mind. In their role-play, even very young children "become" a baby or a mom, a cat or a dog, a scary monster or a monster-robot.

These abilities appear around the age of two. They culminate at the ages of 5-6, and they diminish prior to adolescence to reappear again, as adult art forms (as in theater, puppet-shows, art performances).

Role-play and pretense = make believe: Role-play, is about pretending to be someone else. Early manifestations of role-play appear around the age of two, when children engage in activities like feeding and talking to a doll, or drinking out of empty cups. Well-formed pretense involving complex scenarios is unlikely before the ages of 3 or 4. It culminates around the ages of 5-6, and diminishes again before adolescence. Through pretense, the children get a chance to *dramatise* many intriguing events, sometimes changing the original event's outcome, which helps them come to grips with some of the hardships that growing up entails.

Role-play and imagination = make it up: To imagine, is about envisioning alternative ways, which, in turn, involves a decoupling between *what is* and *what could be*, between the *actual* and *the possible*, between *facts* and *fancy*.

"No child will build forever, without., at some point, imagining a plot or scenario that drive the characters she invents and impersonates"

Early manifestations of imagination appear, together with pretense, around the age of two, as children start to tease their siblings and to crack their first jokes. A child's imagination, or fantasy, does not fade away with age. It just changes nature, adapting to achieving serious tasks, as children start school. Nor is it a quality reserved to poets alone. Instead, it permeates all walks of life, from scientists to gardeners, and becomes ever more elaborate as a child grows up.

Role play and building = make dreams come true: Children not only *make up* things in their heads, they also *make* things [make and create], giving form to their inner feelings and ideas. Children speak in gestures, in pictures, and in words, and they *build things* to express what matters to them, to make their dreams come true.

Ackermann contends that no child engages in role-play for long without, at some point, setting the stage in which the play takes place. In other words, as s/he role-plays, a child simultaneously builds the props she needs to enact her fantasies. S/he is both *the architect and actor* of her play.

Role play and story-telling = say it / share it: In the same way that no child engages in role-play for long without setting building the props in which the play takes place, no child will build forever, without, at some point, imagining a plot or scenario (as simple as may be) that drive the characters she invents and impersonates. Children also use narration to punctuate their enactments. They do so by speaking in a character's voice (first person narrative), or else, by commenting on a character's behalf (second person narrative). Enactment and narration go hand in hand. There is no role-play without story-telling. There is no building without authoring and sharing.

As they engage in pretense and role-play, children simultaneously build (set the stage), narrate (tell a tale), and enact (play out) a character's part—each feeding the other to augment the fun! Equally important, in all cases, the fun is not complete if it can't be shared with others, present or absent. The more the merrier!

Creating maps of the mind and pathfinding though play

Sometimes, mental exploration has a specific goal: often, it does not. In this, as in other ways, creativity has much in common with play. Poincaré described the first phase of creativity — 'preparation' — as consisting of conscious attempts to solve the problem, by using or explicitly adapting familiar methods. The problem with this view is that when it comes to creativity and play, there may not be an initial 'problem' to start with, or alternatively, we don't know what the problem is. Like much play, creativity is often open-ended, with no particular goal or aim. Preparation, then, is about turning the mind into a fertile ground for ideas *through exploration* — where the terrain explored is *the mind or problem itself* — helping define it. Problem-setting is as important as problem-solving in human creativity.

Explorations of conceptual spaces through play are initially about path-finding, fueled by the affordances of the terrain. Another helpful metaphor for the navigational techniques used by children in their play is the concept of path-finding using guiding stars as has been suggested by Hutchins and others. Much of this is unconscious, intuitive - and only later can one begin to recognise the landscape based on the map, as the terrain is not the map, but an abstraction of it. Yet the analogy of a map or a guiding star is useful as one can return to old places by new paths: In short, the map or guiding star can be used to generate an indefinite number of very useful 'coulds' and 'cannots'.

Ackermann captures the notion of the unconscious, intuitive element preceding the more conscious effort of navigational path-finding when she highlights the fact that children are more like Picasso when he states, jokingly, about himself "I do not seek. I find."[83] More to the point, children are 'natural' creators, or innovators *by necessity*. They excel in the generation of new ideas *because of* their own lack of experience and knowledge—which in turn, endows them with an awesome ability to learn on the fly—thus boosting the cycle of self-directed learning and bringing about much knowledge-in-action.

> There are two types of relationships between inventors and inventive problems. Eight out of ten inventors seem to wait until a problem becomes urgent before starting to work on it. Here, in essence, the problem finds an inventor. Other inventors actively search for unresolved problems.[84]

Children in their play, much like inventors in their work, seem to embrace both avenues for problem-setting and both 'look' for problems as much as wait for the problems to 'find' them. Especially younger children think "out of the box" all the time—and one may even add that they are pretty 'systematic' at it! Yet, they do so in *un-self-conscious* ways. They are creative because they are curious, expansive, and because they like to mess around with anything—and anyone—at hands'/mind's reach.

They are "systematic" because they relentlessly explore what pleases them. It is their desire to play rather than a deliberate effort to innovate that drives their abilities to generate novelty. This being said, and as the saying goes, a child's play is also her most serious work in that through play she systematically engages with the 8 qualities that Claxton mentions as crucial for learning and creativity — i.e curiosity, courage,

83 Byrne (1996): 4. 484)

84 Genrich Altshuller, *The Innovation Algorithm*, transl. by Lev Shulyak and Steven Rodman, Technical Innovation Centre, Worcester, 2nd ed, 2007, p.80.

exploration, experimentation, imagination, reason & discipline, sociability and reflection.

Constructive play and learning - building for Playful Learning

Forman & Hill (1955, p. 2)[85] offer a definition of constructive play that is helpful as a starting point to our discussion: "The child learns through play. In fact, Jean Piaget insists that meaningful learning requires a period of open-ended "playing around" with *alternative ways of doing things*."

Constructive play, by definition, builds on itself to increase the competence of the child. The competence, in turn, increases the child's pleasure by making even more creative acts possible. The cycle repeats itself, with the new creative acts becoming yet another form of play at a higher level of understanding until they are mastered.

Essentially, in constructivism, children are the builders of their own cognitive tools, as well as of their external realities. In other words, knowledge and the world are both construed and interpreted through action, and mediated through symbol use. Each gains existence and form through the construction of the other. Knowledge, to a constructivist, is not a commodity to be transmitted—delivered at one end, encoded, retained, and re-applied at the other— but an experience to be actively built, both individually and collectively.

Similarly, the world is not just sitting out there waiting to be to be uncovered, but gets progressively shaped and formed through people's interactions / transactions. In learning, the constructivist thinking is particularly powerful as it asserts itself in opposition to the traditional instructionist approach, that Seymour Papert describes as 'I tell you what I think you should know'. This approach implies the listener as the passive recipient of information, whereas the opposite is true of the constructivist learning approach. Here curiosity and playfulness function as the forces driving self-directed learners to actively construct knowledge in the world – using their curiosity to ask exploring questions and attempting to replicate the mechanisms behind the magic or indeed playfully imagining completely new ways of doing things, thus using exploratory creativity to expand their understanding of an area.

Development, as Piaget phrases it, is a spiral of knowledge moving upward through alternating play and skill". Another characteristic of constructive play, central to Piaget's theory, is that the player herself must do the construction. Meaningful learning is more likely when the child herself invents the alternative ways of doing something.

In fact, if the child is only imitating alternatives modeled by a teacher or a parent, we do not call it play; it becomes a drill. However, if the child herself invents some new ways to do something, the chances are that she will also better understand how that new way relates to the other ways in which she has performed the act in the past. Of course, things are not that simple - sometimes modeling by a teacher or parent is just what is needed to prime a child to begin her own inventive play. The point remains, however, that invention by the child is essential to constructive play.

Clearly, the occurrence of constructive play requires a supportive environment provided both by the quality, or affordances, of the materials at hand (or objects to think with) as

85 Constructive play: Applying Piaget in the Preschool (1984). George Forman and Hill Fleet. Addison-Wesley Publishing Co.

well as the presence of caring adults (a sensitive parent or teacher) and peers (other children to play with).

Constructivism and the connection between creativity and learning is explored further in Chapter 4.

Freedom vs. Constraint - playing as "leaping"

The American Heritage Dictionary of the English Language, 3rd Edition (1992) defines play as the ability "to move or operate freely in a bounded space." The metaphor of the "leap" has often been used to capture the sense of exuberance and freedom that characterize children's play, as well as its boundary-crossing nature. We leap out of constraints in order to feel free, and we leap across frames to explore things more openly.

However, we can't just leap without a place to land, and there would be no levity without gravity, no freedom without boundaries. It is in this deep sense that play is not merely an escape from reality but the freedom to fully participate in, transform and be transformed by the world.

As John Holt so eloquently put it in his book *How Children Learn,* "Children use fantasy not to get out of, but to get into, the real world".[86] It is their way of understanding it and coming to grips with their experience, turning it over and owning it. To play is to become a part of a reality in constant transformative engagement with itself.

When we play, we feel the intrinsic joy and vitality of being in the flow of things and in tune with people. At the same time, we give ourselves the permission to "leap out," or bifurcate from the beaten path, at any time. If participation doesn't always bring about innovation, it grounds us. "Leaping," on the other hand, involves taking off. Creative exploration requires both head-in-the-stars (envisioning possibilities) and feet-on-the ground (being-in-the-world): It is the dance between the two that matters, the freedom to embrace both that counts, and the engagement with the materials-at-hand that keep the dance going.

The freedom of play is absent in any activity that has become rigid, unconscious, habitual, or compulsive, even if it started out as play. If the rules and order become too restrictive, chaos can stir things up, disrupt the status quo, and revitalize the play.

Play requires both boundaries (order) and the impulse to cross them (chaos). Play furthermore does not disappear with adulthood. It only diminishes when we confuse our development with the increase in seriousness instead of the increase in dimensions of play.

Conclusions

Ultimately, play comes in many shades and free building, or "messing around with materials," is inherent to play itself. In a child's mind, the play rarely just starts when the building is over. Quite the opposite: messing around with materials is often what sparks a child's imagination and sustains her interest and engagement: you get started and the ideas will come. You persevere and the ideas will fly.

Much like the many diverse ways one can engage with music, from listening and appreciating, to dabbling with making sounds on an instrument, to playing music from a score and improvising or 'jamming' with others in a band - similarly, LEGO shares this

86 John Holt, *How Children Learn,* Merloyd Lawrence, Delta/Seymour Lawrence, New York, 1982, p.238.

diversity as a creative material and system. In the case of music, the forms that emerge are aural. In the case of LEGO, they are tangible.

Constructive play, much like playing a musical instrument, helps children bring their imagination to life through a process of open exploration, or intelligent form giving. This process is both free and constrained, loose and principled. This is especially true when the materials at hand are open-ended (they have a low entry level, yet enable mastery - i.e they let you grow and grow with you) and 'principled' (they have an integrity, or 'logic' of their own).

Moreover, in children's play in general, as well as in LEGO play, different play-types, or ingredients such as construction, fantasy, role-play and storytelling are often combined. As children engage in play, they simultaneously build (set the stage), narrate (tell a tale), and enact (play out) a character's part as well as iteratively move back and forth between each phase. Constructive play and fantasy play feed one another at each step of the constructive/creative process and collectively augment the fun.

In all cases, the fun is not complete if it can't be shared with others, present or absent. While children may differ in how stereotyped or free-floating, realistic or archetypical their explorations and enactments may be, what they all share is an underlying need (urge / desire / aspiration] to explore alternatives and to generate variations. It is mostly through messing around with principled materials in meaningful contexts that children come to 'see' what the ideas are that they would like to pursue, and how to take the next step in exploring the idea further.

4

Chapter 4

What is the connection between creativity and learning?

What is the connection between creativity and learning?

4

"If the head and the hand act separately they conclude nothing: if they work together they can accomplish something, but much more can be done when head and hand work together with a tool". [87] – Francis Bacon

Give the mind a hand, and the hand a system

Giving the mind a hand suggests that a child's systematic creativity is both mental and physical (think and act at the same time). *Giving the hand a system* further suggests that the building materials, in this case LEGO® bricks, offer a rich repertoire of patterned elements (parts and connectors), the *constraints* of which (a visual-tactile language with a "logic") help sustain mindful engagement through playful exploration.

Neuroscientists found some time ago that a surprisingly large proportion of the brain's motor controls were dedicated to the hand (Penfield & Rasmussen, 1950). The brain has a continuous interactive relationship with the hands, which means that the hands are not simply a valuable place to get information 'from', or to manipulate objects 'with', but also that 'thinking with the hands' can have meaning in itself.

Swiss psychologist Jean Piaget (1896-1980) argued that intelligence grows from the interaction of the mind with the world – through connected physical activity such as making with the hands. His notion of constructivism is one of the principles upon which LEGO Serious Play, discussed later in this chapter, is based. Piaget explained constructivism as follows:

> Knowledge is neither a copy of the object nor taking consciousness of a priori forms pre-determined in the subject; it's a perpetual construction made by exchanges between the organism and the environment, from the biological point of view, and between thought and its object, from the cognitive point of view… The major problem in knowledge, since it isn't a copy of reality, a copy of objects, is the way it reconstructs reality. In other words, reality must be known, of course, but by recreating it through deduction and endogenous construction[88].

The 'object' here does not necessarily mean a physical object, but any object of thought, such as a memory or a fear. Following Piaget, Seymour Papert, went on to use these ideas in his own notion of constructionism stating that building knowledge occurs best through building things that are tangible and shareable. Papert says that constructionism might be summarised as 'learning-by-making', but is

87 In "Shoes and meter: Children and measurement." Reggio children (Castagnetti, and Veavechi Eds). RE: Reggio Children Publications 1997. p. 10.

88 Jean Piaget, *Conversations with Jean Piaget*, interviews by Jean-Claude Bringuier, University of Chicago Press, Chicago, 1980, p. 110–111.

quick to assert that it is 'much richer and more multifaceted' than such a simple formula might suggest (Papert and Harel, 1991). Its origins are explained in this story that Papert tells about when he was a specialist in mathematics education, and was working on a project at a Junior High School in Massachusetts in the late 1960s. On his way to the math class, he walked past the art room each day:

> For a while, I dropped in periodically to watch students working on soap sculptures, and mused about ways in which this was not like a math class. In the math class students are generally given little problems which they solve or don't solve, pretty well on the fly. In this particular art class they were all carving soap, but what each student carved came from wherever fancy is bred, and the project was not done and dropped, but continued for many weeks. It allowed time to think, to dream, to gaze, to get a new idea and try it and drop it or persist, time to talk, to see other people's work and their reaction to yours – not unlike mathematics as it is for the mathematician, but quite unlike math as it is in junior high school. I remember craving some of the students' work and learning that their art teacher and their families had first choice. I was struck by an incongruous image of the teacher in a regular math class pining to own the products of his students' work! An ambition was born: I want junior high school math class to be like that. I didn't know exactly what 'that' meant but I knew I wanted it. I didn't even know what to call the idea. For a long time it existed in my head as 'soap-sculpture math'[89].

In other words, Papert noticed that when students were making something with their hands (such as soap sculptures), they were in a deeply engaged state, whereas when they were making something rather abstract in their minds alone (such as solutions to math problems), they were much less engrossed. Papert therefore resolved to develop forms of learning, in different spheres, which would utilise the benefits of this 'hands on' process. The level of fascinated engagement Papert noticed in the art class was that state which Mihaly Csikszentmihalyi would later call 'flow', as discussed above.

In recent years, there is much talk among researchers about the importance of tactile / kinesthetic exploration besides vision and language, and about the role of enactive representations, embodied knowledge, and tangible interfaces in human learning, and creativity. It seems that we only truly know what we know through the continuous loop of perceiving the world through our actions and adjusting our actions based on our perception.

Danish associate professor Hans Henrik Knoop, of the Danish Pedagogical University has asserted that an optimal (i.e conducive to the Flow state) learning environment for self-directed learners has 3 qualities: Firstly, it is one where the topic is meaningful, secondly the student's skills are in balance with the challenges at hand and lastly that the students have the relevant tools, further supporting both Papert's notion of 'constructing knowledge' as well as Karmiloff-Smiths findings about the need for a medium to assist our embodiment of knowledge.

89 Seymour Papert, and Idit Harel, 'Situating Constructionism', in *Constructionism*, Norwood: Ablex Publishing. 1991, Available at http://www.papert.org/articles/SituatingConstructionism.html

5 phases of Creativity and Human Learning

Csikszentmihalyi's five-steps model offer a useful framework to rethink informal learning, beyond creativity. Although initially designed to capture moment in the creative process, the five-step model ironically—but not surprisingly—lends itself very well to describe key moments in the cycle of self-directed learning, as manifested in children's play. This is because learning itself IS about new ways of looking at things

1. Preparation: becoming immersed in —and sensitive to—problematic issues that are interesting and arouse curiosity.

During this phase, learners ask questions, and explore options. They gather data and information. They read, inquire, and quest. And, in many cases, they just mess around with materials as a way to become further engaged.

Crucial at the beginning of any learning process is the notion of *problem-setting*. Indeed, asking the right questions seems more important, at this early stage, than rushing to find solutions. Equally important is Claxton's notion of learning through osmosis, or implicit learning, as a crucial companion to the more deliberate form of quest mentioned above.[90] Know-how is implicit understanding, bourn out of curiosity and based on our ability to learn from everyday experiences.

2. Incubation: ideas churn around below the threshold of consciousness.

During this phase, learners' ideas self-organize without their being aware of it! This doesn't mean the learners are passive. Quite the contrary. They may interact with others, doodle, mess around with materials, or simply 'ruminate'.

Older learners voluntarily engage in routines to get their minds *to work for them* (as when we 'sleep on it', or "take a break" and the problem gets clarified, or even resolved). They know how to shift gears (or jumps side-wise) to help their mind to gather, and ideas come to them. Younger learners, by contrast, are more likely to engage in open-ended hands-on exploration as a means to let objects 'talk back' to them, and in doing to learn about a situation. In both cases, learners are endowed with a 'know-how' or implicit understanding, bourn out of curiosity, which enables them to learn from their everyday experiences.

During incubation, learners often feel they are making no progress towards the solution of a problem. They are spinning their wheels while progress is "being made" on their behalf. This indirect 'priming' has been proved by Yaniv and Meyer, and sets the stage for those sudden, out-of-the blue experiences, referred in the next step in the creative process, the insight.

3. Insight: the "Aha!" moment when things suddenly fall into place

Insight is a life-bearing moment when ideas suddenly fall into place as if 'out of the blue': a very rewarding experience that gives learners the "oompf" to move on.

A strong motivation booster, insight connects learners back to their desire to pursue their quest, or inquiry. During 'aha' moments, learners also come to realize that all their hard work, meanderings, and apparent lack

90 Claxton, *Hare Brain, Tortoise Mind*

of productivity during incubation was not in vain.

4. Evaluation: deciding if and insight is valuable and worth pursuing.

During this phase, learners check-out their insights to determine if they were good ideas, after all! An idea may be surprising or seducing, but whether one holds onto it, often comes down to whether the idea is deemed valuable in some way.

The evaluation stage could be characterized as the "and so what?"moment.. That's when learners start to wonder: What's new? How will my idea be received? Has someone already thought of it? Is it feasible? How can this insight be integrated to what I already know? If it can't am I willing to rethink everything else?

5. Elaboration translating valued insights into a final form.[91]

During elaboration, learners engage in the hard and time-consuming work of turning a promising set of ideas into a final product. Elaboration is about intelligent form-giving, or design. It is about drafting, crafting, and polishing one's drafts, and making ideas tangible and shareable.

Constructivists talk about the need to externalise an idea, give it a form, a shape to help the mind engage with it using both know-how and knowledge, the implicit and explicit parts of our understanding.

Systems offer a bridge between creativity and learning, in that we use systems in our mind to generate meaning, explore our understanding of the world, as well as express our understanding and ideas/artefacts/knowledge through systems. Papert's constructionism brings this relationship even closer as the idea of an *optimal learning environment is one where the activity engaged in is perceived as meaningful, one's abilites are in balance with the challenge at hand, and one has the tools to express the emerging knowledge*.

"The process of preparation, incubation, insight, evaluation and elaboration lends itself not only to understanding the phases of creativity, but also learning"

In such a context one becomes a self-directed learner and actively pursues learning for its own sake, out of intrinsic motivation. Thus the process of preparation, incubation, insight, evaluation and elaboration actually lends itself well not only to understanding the phases of creativity, but also learning, yet with the crucial difference: The *objective of the creative excercise is generating ideas or artefacts* that are new surprising and valuable, whereas the objective with *self-directed learning is generating knowledge that is new, surprising and valuable for the individual*.

Systems allow for creativity and learning to inter-twine by stimulating the imagination, allowing knowledge to be built and ideas to be explored – allowing us to break free to see things in a new way, whether to generate ideas and artefacts or indeed to learn something new.

91 Csikszentmihalyi, *Flow,* p. 79.

5

Chapter 5

Can creativity and learning be achieved systematically?

Can creativity and learning be achieved systematically?

5

Systematic - 1. Having, showing, or involving a system, method, or plan: *a systematic course of reading; systematic efforts*. 2. characterised by system or method; methodical: *a systematic person; systematic habits*. 3. arranged in or comprising an ordered system: *systematic theology*. synonym: orderly[92]

Mindsets matter — Intrinsic motivation, sense of purpose, and creativity -

Research by Carol Dweck on "achievement motivation" in students shows that the implicit "theories" that people held about what it means and takes to be intelligent—or a good learner—inform how they will go about solving problems, overcoming obstacles, and handling complexity and uncertainty.

Dweck identified two basic theories of intelligence that, if projected onto self, affect how a person gauges her abilities to face challenges and handle problematic situations. In a nutshell, Dweck shows that individuals who have "fixed" mindsets view intelligence as an unchangeable mental gift that cannot be bettered from within. By contrast, individuals who have "growth" mindsets believe that intelligence is malleable, and thus can be optimized through will and work. Dweck's empirical studies brings strong evidence to the further notion that students with fixed mindsets are less likely to engage in challenging tasks, and are at risk of academic underachievement. They become helpless in situations where they feel judged, and because they feel helpless, they tend to attribute their successes and failures to others: they have an *outer locus of control*. By contrast, students with growth mindsets believe that, to a great extent, they can impact their abilities, and thus recover more easily when failing or being judged: They have an *inner locus of control.*

Building on Dweck's work, Guy Claxton (2008) used the metaphor of brains as 'learning muscles' as a banner for his own incrementalist's view. To Claxton, intelligence can be improved, provided learners know how to put their mind to it! In his words, there are many 'qualities of mind – pleasures and inclinations as much as abilities',[93] that can be nourished and developed, and that lead young people to be more confident and better able to deal with problems in their lives (Claxton 2008: viii). Claxton identified eight qualities that make for "powerful learners": *curiosity, courage, investigation, experimentation, imagination, reasoning, sociability and reflection*.

It appears thus that an individual's inner motivations are crucial in creating a

92 *College Dictionary,* Random House, New York, 1992.

93 Claxton, *What's the Point of School?*

systematic, or predictable, or repeatable success when it comes to either learning or indeed, creativity. In what follows, we detail, for each of Claxton's qualities, how they enhance 1. learning and 2. creativity:

Developing learning ability through nurturing mindsets

Claxton's idea of 'learning muscles' is based on an understanding that intelligence is not a fixed amount of capacity in an individual, but is a flexible property that can be stimulated, encouraged and strengthened. Intelligence here is not something that can be demonstrated by speedily completing some IQ tests. On the contrary, proponents of this view cite the psychologist Jean Piaget, who said that intelligence is 'knowing what to do when you don't know what to do'. Similarly, Lauren Resnick has said that 'One's intelligence is the sum of one's habits of mind'. It is about being able to face challenges creatively.

In the same way that physical exercise requires that the body be 'pushed' to some extent, the brain is stimulated by difficult problems. It therefore follows that children and adults should not always be kept in the comfortable zone of completing easy puzzles using ready-made solutions. This is especially true for the kind of challenging and creative work which is expected of today's employees, which Claxton describes as 'a knowledge-making world, not a knowledge-applying one' (2008: 79).

As mentioned before, Claxton presents a list of eight qualities or dispositions which describe a powerful learner:

Powerful learners are *curious*. They are drawn to learning, ask questions, and wonder about how things work.

Confident learners have *courage*. They are not afraid of uncertainty and complexity. They have 'mental toughness', and so do not dwell negatively upon setbacks or mistakes, but bounce back and learn from them.

Powerful learners are good at *exploration* and *investigation*. They like to find things out.

Powerful learners use *experimentation*. They fiddle with things, change and adapt them, to uncover their potential.

Powerful learners have *imagination*. They can look at the world from a range of perspectives, and can mentally generate and explore possibilities.

Their creativity is tied to *reason* and *discipline*. They can work out logical explanations and critically evaluate their own ideas, and those of others.

Powerful learners have *sociability*. They like to share ideas and collaborate, and can work well in teams – although they can balance this with solitary reflection, where needed.

Powerful learners are *reflective*. They see themselves as continually growing, and can take 'a step back' to critically contemplate what they have been doing, and what their assumptions have been.

(Abridged from Claxton, 2008: 123–126)

The idea of 'creativity muscles'

It is clear that alongside the notion of 'learning muscles', we can think about those 'creativity muscles' which can be exercised and developed. Although Claxton's list is primarily about 'powerful learners', it also makes a lot of sense to say that exercising the 'creativity muscles' would strengthen all of these important qualities. Ackermann ventures to define how each of Claxton's qualities relate to creatives:

1. **Masterful creatives are often *playful, in addition to being curious*** *They use enchantment as a lever to grow and thrive.*
2. **Confident creatives have courage.** Beyond being "mentally tough" master creatives are often "flexibly centered": They give in while keeping a bearing; "get lost" in order to find new ways; take detours to better dwell.
3. **Masterful creatives balance exploration and investigation with pattern-finding.** They use lateral thinking, reframing, and divergent and convergent thinking as techniques to avoid burying themselves into holes. They brainstorm, find paths and move on!
4. **Masterful creatives not only experiment, they find.** Creatives are sometimes designers more than problem-solvers (preference for open ended situations where more than one solution is usually possible).They are bricoleurs, in Levy-Strauss's sense (collector / found art approach to making / creating) using combinatorial creativity to explore id ideas fit together.
5. **Powerful creatives rely on and use their imagination continuously** Creators rely on their ability to making things up, over realism (mimicking "reality") and often strive for meaning rather than truth. They generate ideas and use the ideas to illuminate an

area (exploratory creativity) they are trying to understand.

6. **Masterful creators balance rigor and playfulness, reason and fantasy, logic and lateral thinking.** They "systematically" seek out opportunities to learn from the materials at hand, and they often favor intelligent form-giving over logical explanations.
7. **Powerful creatives are social.** Creatives usually like to engage or enchant others through what they do (seduction) rather than convincing them through explaining things (didactics).
8. **Creatives are reflective-in-action.** What matters to them is to stay in touch, be in tune, get in the flow. Reflection, to them, is about building up readiness in situ.

Claxton describes two 'buried metaphors' which underpin how people typically think about education. One is the monastery, where God's Truth is handed down by wise masters, and the other is the production line, where standardised procedures are meant to produce batches of educated persons. Claxton suggests a more fruitful metaphor would be the 'learning gymnasium' – a place that develops 'learning stamina' and stretches those 'learning muscles', so that people become more 'confident, capable, powerful learners' (2008: 127).

Again it seems reasonable to rethink this notion in terms of a 'creativity gymnasium,' a place where creativity muscles are developed and stretched, and to suggest that this is exactly what is offered by the LEGO® System.

The pursuit of excellence – the role of mindsets in the psychology of sports

The pursuit of excellence in sports requires a particular type of dedication and discipline—and associated mindsets. While tangential to creativity itself, sports offer a useful window into what aspiring athletes typically do to get ready for peak-performance. It sheds light on the embodied nature of human learning, and on the powers of will to overcome physical and mental limitations.

Terry Orlick postulates that beyond physical ability and training the key to mastering excellence in sports is the ability to focus on the athletic performance and maintain that focus in spite of distractions and in adverse conditions. He details 8 mindsets that can be trained and developed, which both individually and collectively influence one's ability to focus and through superior ability to focus, master excellence:

Commitment:
The pursuit of excellence starts as one engages in a task that is absorbing, challenging, gives a sense of meaning, joy, and passion, i.e. Flow as described by Csikszentmihalyi. Higher levels of excellence require a positive vision of where we want to go and a heartfelt reason for doing it.

Mental Readiness
Mental readiness has everything to do with being focused, persistent, and fully committed to act on our intentions. Higher levels of excellence require that we get mentally ready for focused, decisive action. The ultimate benefit of mental readiness is that we will be focused on getting the best out of what we have right now – at this point in our training,

performance, season, career, and life. We must also be mentally ready to draw lessons from each of our experiences and act on them.

Positive visions and images
Many great accomplishments, discoveries, and seemingly impossible feats begin with a single positive vision or what we want to accomplish and smaller visions of the steps we are going to take to get there. One of the main benefits of having a big positive vision and smaller step-by-step visions is to keep us focused on the positives and the possibilities (why we can do it, why we want to do it, and how we will do it) as opposed to focusing on the negatives (why we can't do it).

Confidence
Confidence is integral to the pursuit of excellence. It rises or falls based on the quality of preparation, the sharpness of focus, and the extent to which we believe in our capacity. Confidence comes from committing to do the preparation or quality work. We grow confidence by rejoicing in the things we do well, acknowledging our improvements, learning from our failures and successes, absorbing the wisdom of others, and discovering that focus frees us to perform our best. Confidence in our focus is like a master key: It opens the door to higher levels of excellence, and higher levels of excellence open the door to greater confidence.

Distraction control
Distraction control is about not allowing distractions to interfere with the success of our pursuit. Some distractions are external, arising from other people and their expectations or from specific circumstances in our environment. Others are internal, arising from our own thinking, doubts, worries, fears, or expectations. Distraction control is especially important when we feel stressed, crowded, pressured, uncertain, or unappreciated, or when we are performing in demanding circumstances. Great performers are able shift and regain focus by using simple reminders, images, or focus points that reconnect them with something positive that is within their immediate control.

Ongoing Learning
High-level performers are superb self-directed learners. The pursuit of excellence is a process of self-discovery and stretching

"Confidence is integral to the pursuit of excellence. It rises or falls based on the quality of preparation, the sharpness of focus, and the extent to which we believe in our capacity"

limits, acting on the lessons learned on an ongoing basis. Great performers attain high levels of excellence because they are committed to ongoing learning. They prepare well, focus well, deal well with distractions, do thorough post-performance evaluations, and act on the lessons that they draw from their experience. They gain inspiration, confidence, and inner strength by finding simple joys within their pursuits, looking for personal highlights, and continue to reflect on what frees them to live fully and perform their best. They also grow from setbacks by channelling their lessons and energy toward their improvement.

(Abridged from Orlick, *In Pursuit of Excellence* (Champaign: Human Kinetics, 2008) pp 13-21)

Purpose, pleasure, meaning, and positive emotions in human learning and creativity

The pursuit of happiness

Positive psychology—also defined as the scientific study of optimal human functioning[94]—offers another useful window into how people handle the hard-to-solve tensions between success, purpose, and meaning as they seek *to live fuller lives* (well-being beyond performance). While tangential to creativity itself, it helps to understand the adaptive (and not so adaptive) attempts at juggling long-and short-term benefits, and how these attempts, in turn, affects individuals' styles of knowing, or relating to the world.

In the footsteps of Csiksentmihalyi, scholars like Tal Ben Shahar, Martin Seligman, and Loehr and Scwarz studied the qualities of mind—and types of guidance—needed to help people function adaptively, and enhance the qualities of their lives, from within. Common to these authors are the notions that no "5 steps to happiness" will ever do and that self-discipline is usually insufficient when it comes to fulfilling our commitments—which is why most new year's resolutions fail (p.9). Instead, change for good requires *rituals* as a means to keep going in spite of local ups and downs, a *sense of purpose* motivated by deeply held values, and an openness to pleasure beyond set goals.

Tal Ben-Shahar[95], argues that lasting happiness, or personal fullfilment, arises neither from seeking immediate satisfaction nor from delaying gratification. Instead, it requires an ability to balance present and future benefits.

Optimal functioning, in other words, requires that we get in touch with present feelings (positive or negative) and that we learn to recover from both the bliss that accompanies temporary highs (successes) and the feelings of emptiness that usually follows (failures).
What matters is how we come to grips with the competing archetypes within both over time and across contexts.

Obviously, we don't suggest that being happy is a pre-requisite for being creative, or a good learner. Many wonderful artists and creative people live hard lives — and don't always make for the best partners—and many children in this world are not in a position to being in the "sweet spot (happy state) all the time.

94 This definition is taken from The Positive Psychology Manifesto, which was first introduced by leading researchers in the field. The full definition: "Positive psychology is the scientific study of optimal human functioning. It aims to discover and promote the factors that allow individuals and communities to thrive. The positive psychology movement represents a new commitment on the part of research psychologists to focus attention on the sources of psychological health, thereby going beyond prior emphasis upon disease and disorder:. The full manifesto can be found on-line at http://www.ppc.sas.upenn.edu/akumalmanifesto.htm.

95 Tal Ben-Shahar, *Happier*, Mc Graw Hill, New York, 2007.

What we do suggest, however, is that systematic creativity offers a good way to get children to learn how to balance conflicting mindsets, and conversely, becoming self-aware and learning to balance conflicting mindsets is an exceptionally good way to help children sustain engagement in creative tasks, particularly in situations of complexity and uncertainty.

The role of goals[96]

In "Zen and the art of motorcycle maintenance"[97], Robert Pirsig describes joining a group of elder Zen monks mountain-climbing in the Himalayas. Though Pirsig was the youngest member of the expedition, he was the only one who struggled; he eventually gave up while the monks effortlessly ascended to the peak.. Pirsig focused on the goal of reaching the peak and overwhelmed by what still layed ahead, was unable to enjoy the climb. He lost his desire and strength to carry on. The monks also focused on the peak, but only to make sure they were staying on course, not because reaching the peak itself was most important to them. This allowed them to enjoy each step, rather than being overwhelmed by what still lays ahead.

The important lesson here is this: the proper role of goals is ironically to liberate us so that we can enjoy the here and now. In other words, if we have a destination in mind, we are free to focus on making most of where we are, In Ben Shahar's words "the emphasis is not so much on *attaining goals* as it is in *having* them, and the primary purpose of having a goal—a future purpose — is to enhance enjoyment of the present." (p. 70). Imagine your life as a journey. Not having a destination makes you hesitatant at each bifurcation: where should I go? Left, right? What if… This can become a heavy load on the human psyche.

Purpose, pleasure, and meaning

In " Man's in search of meaning"[98], Psychiatrist Viktor Frankl states: "what man actually needs is not a tensionless state but rather the striving and struggling for some goal worthy of him. What he needs is not the discharge of tension at any cost, but the call of a potential meaning waiting to be fulfilled by him". This being said, meaning alone is not enough to function optimally. What we need instead is both the experience of *meaning* AND the experience of *positive emotions*. We need to balance present and future benefits; to feel the reasons behind our emotions; and to know that our actions can actually make a difference in the world—and to ourselves.

Without positive emotions, there is no motion, or motivation: In Ben Shar's words "Emotions cause motion, they provide a motive that drives our action. The very language we use suggests that emotion, motion, and motivation are intricately linked . Positive emotions move us away from a desireless state (p 35).

A model for sustaining engagement in creativity

Judging by the above, developing mindsets emerge as crucial in any quality, which consists of many ordinary abilities, such as intelligence, creativity or indeed mastering excellence in sports. It appears that it is indeed possible to achieve learning or creativity systematically, but that without the ability to focus and the pre-requisite mindsets, or a balance between present and future benefit, both learning and creativity can become more haphazard (driven by an

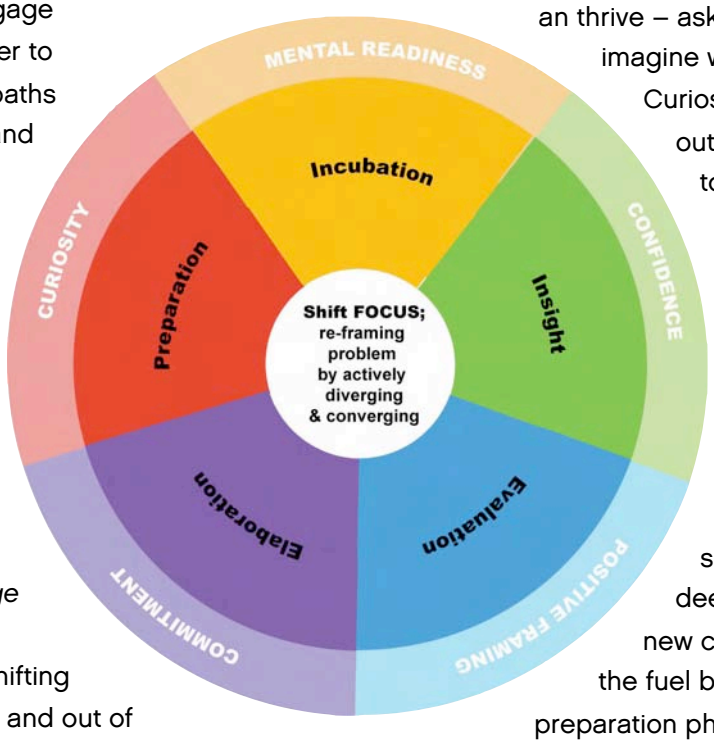
96 Tal Ben Shahar, *Happier*, pp. 69-10.

97 R.M Pirsig, *Zen and the art of motorcycle maintenance: An inquiry into values*. Bantan books, 1984.

98 Viktor Frankl, *Man in search of meaning*, Beacon press, 2006.

outer locus of control) rather than systematic and self-directed.

In order for an individual to be able to engage the creative process systematically, or methodically exploit the different phases of creativity in a self-directed fashion, the following model emerges. At the heart of the creative process is the ability to deliberately control one's focus, and actively diverge and converge in order to frame the problem. The purpose is to enagage imagination in order to break off beaten paths to find new ways and accepting to momentarily "get lost"(surrender control) as a detour to "get one's act together" (or gain mastery). *Bifurcate to innovate*, or *diverge to converge* is all about 'displacements' (shifting focus / zooming in and out of target / taking on different stances / suspension of disbelief.



The mindsets of *curiosity, mental readiness, confidence, positive framing and commitment* emerge as the key mindsets behind an optimally functioning creative process. They fuel each of the stages of the creative process, including the iteration between phases bourne out of the ability to use focus to frame the problem in more fruitful ways, giving rise to new ideas.

The five mindsets behind systematic creativity

1. **Curiosity** Curiosity fuels learning, drives individuals to ask questions, and wonder how things work. Curiosity coupled with playfulness means enchantment becomes a lever to grow an thrive – ask what if as well as imagine what could be. Curiosity can be outwardly directed, towards the external world, or it can be inward-looking and reflective, mulling over what has already been learned, searching for deeper meaning and new connections. It is the fuel behind the preparation phase of the creative process.
2. **Mental readiness** Mental readiness has everything to do with being focused, persistent, and fully committed to act on our intentions. When being playfully receptive, inward and solitary and in a state of relaxation and alertness, we are in the optimal mood for good ideas to emerge and propel the incubation phase on towards insight.
3. **Confidence** Being confident has a big impact on our ability to tolerate uncer-

tainty, be open-minded, take risks, engage in questioning, be patient, defer judgement, be resilient and show empathy, habits that are all key to being creative. It rises or falls based on the quality of preparation, the sharpness of focus, and the extent to which we believe in our capacity. We grow confidence by rejoicing in the things we do well, acknowledging our improvements, learning from our failures and successes, absorbing the wisdom of others, and discovering that focus frees us to perform our best.

4. **Positive framing** Many great accomplishments, discoveries, and seemingly impossible feats begin with a single positive vision of what we want to accomplish and smaller visions of the steps we are going to take to get there. Equally the research into positive psychology shows how important it is to be able to balance short-term and long-term benefit and how goals can be liberating as opposed to oppressive. Evaluation is in itself a critical phase of the creative process, as we hold our ideas up to the light to determine whether they are valuable to us or not, and by being able to positively frame the situation helps us embark on the hard graft of improving the idea rather than giving up.

5. **Commitment** Commitment is essential in enabling the perseverance often required when working with an idea – the value of the idea is often the product of how well the idea has been elaborated, making the value of the idea or artefact more obvious. To be able to sustain the energy to do this, commitment requires a positive vision of where we want to go and a heartfelt reason for doing it and the determination to pursue that vision.

"Many great accomplishments, discoveries, and seemingly impossible feats begin with a single positive vision of what we want to accomplish and smaller visions of the steps we are going to take to get there"

The four paths to achieving creativity and learning systematically

Cultivating the relevant mindsets — Examples from both Claxton's 8 qualities of powerful learners, sports psychology, positive psychology and the proposed mindsets behind optimal creativity, remind us how important our mindsets are for sustainaining focus, persevering through difficulty and believing in our own ability to be creative.

Mindsets play an important role in helping us not only understand what we need in order to be in Flow, but to take responsibility to set up the conditions for Flow to occur. From having an outer locus of control, we gradually move into having an internal locus of control, becoming self-directed in achieving Flow and thus, be more systematic in being creative.

Iterate to innovate: Creativity is hard work (hard fun) — Csikszentmihalyi's 5-step model captures key moments in the creative process, yet the actual coming together of ideas in the making of a tangible and shareable artifact (intelligent form giving) doesn't unfold *linearly* (from 1 to 5). Instead, it takes numerous approximations, detours, and re-visitations before an idea takes shape. Same goes for learning. Makers may build intermediary objects, or prototypes, which they then revisit and revise. They may follow more than one path of discovery. They may jump sidewise as they use chance and unexpected side effect as opportunities (springboards) to drive their process. They may "undo" what they achieved so far in the light of other people's insights. Iterations are key to innovation and learning to iterate by controlling one's ability to focus and use divergent and convergent thinking appropriately to re-frame problems in order to enable new, surprising and valuable ideas or artefacts to emerge.

Build to understand: Creativity is a close conversation with principled materials — World-renowned architects have often said how important building kits have been to their creative development. Engineers, architects, and designers generally like building kits because the kits, better than words, provide them with a concrete "language" to pursue their passions, set their problems, and find innovative solutions to tough problems. Unlike language, building kits offer a symbolic mediation that is tangible, visual, and non-verbal.

Much like Claxton's learning by Osmosis[99], this use of materials, engages know-how and the unconscious, which is more robust and resilient, more resistant to disruption, than our conscious abilities. They kick-start the mind, and particularly the unconscious, and through tactile exploration the materials help circumvent the dilemma highlighted by Karmiloff-Smith in her experiment of getting children to draw imaginary men, where the children's inflexible 'man-drawing procedure', was getting in the way of children drawing imaginary men with two heads.

Building blocks, much like drawing can be assembled in a linear fashion, but they can also be picked apart de-linearly and part be substituted, re-built and modified - a physical manifestation of the heuristics older children in Karmiloff-Smith's experiment began using, when giving form to their imaginary men.

Indeed, people's ability to pick up the skills that their everyday lives require - their 'practical intelligence', as Harvard psychologist Robert Sternberg calls it - is independent of their intellectual or linguistic facility and vary much less from person to person, than does IQ. Our fundamental priority is not to be able to talk about what we are doing, but to do it - competently, effortlessly. And when it comes to articulating complex three-dimensional ideas, what more intuitive way to work with those creative problems than through a 'language' that is tangible, visual and non-verbal.

Master a tool: Creativity and learning as deliberate tool-use — Once creators have acquired the skills and confidence to express and communicate ideas using a certain tool (or set of tools), this tool becomes like *second nature*.

Before that, however, the precise and deliberate use of a tool, or technique, may seem strange to them. It is like learning to ride a bicycle. At first, riding a bicycle is awkward and frustrating. You know you would go places faster walking. But once you pick up the skills of cycling, cycling augments the walking in both useful and delightful ways. If a person claims a tool won't work for her, it is often because she has not yet developed the skills to use it well. Techn[olog]ical fluency is a condition *sine qua non* of creative expression and the ability to use that tool to explore our understanding of an area enables both self-directed learning and creativity.

"The use of materials engages know-how and the unconscious, which is more robust and resilient, more resistant to disruption, than our conscious abilities"

99 Claxton, *Hare Brain, Tortoise Mind.*

6

Chapter 6

How does the LEGO® System of Play support learning and systematic creativity?

How does the LEGO® System of Play support learning and systematic creativity?

6

The LEGO System of Play is first and foremost a system. It has much in common with other systems discussed in this document, but of course has unique properties of its own. This understanding of the LEGO System is central as we proceed to discuss how the LEGO System of Play supports self-directed learning, and how it lends itself to creative expression. Moreover, clarifying how these are intertwined forms the basis for understanding systematic creativity, and ultimately the success of the LEGO System of Play as a creative and learning medium.

The philosophy of the LEGO System - "Play Well - LEg GOdt"

The LEGO System is obviously related to its interconnecting physical parts, based on the 50-year-old LEGO brick and the other shapes, sizes and colours of parts which connect with it. The system also involves an ethos which is just as important, although less tangible. The elements of the LEGO System therefore involve all of the following.

An interconnecting set of parts. Connections come easily and sometimes in unexpected ways.

A low entry level for skills, so that anyone can pick up LEGO bricks and make something satisfactory and meaningful – although a developed level of expertise is also rewarded as the system can be used to create both very simple and very complex constructions.

The ability to create something where previously there was nothing – coupled with the lack of need for preparation and planning: as they say in LEGO Serious Play, 'If you start building, it will come'.

An open system with infinite possibilities. It can grow in all directions and the parts can be combined in limitless ways.

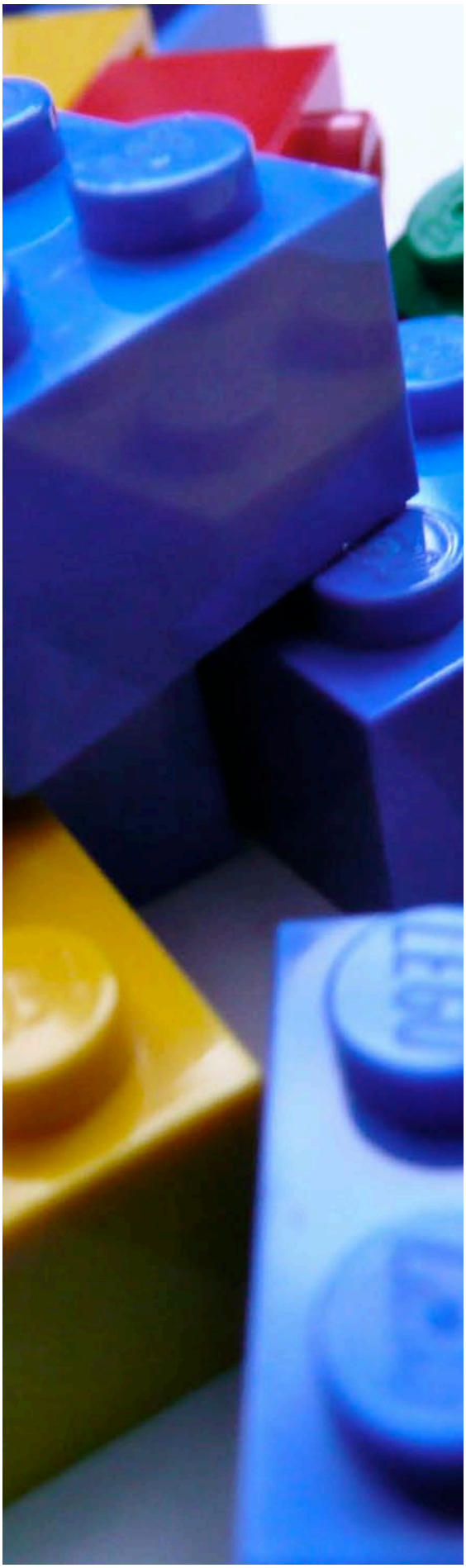
A belief in the potential of children and adults and their natural imagination – that anyone can make and express whatever they want to, through the system.

A belief in the value of creative play, and a respect for play as a powerful vehicle for learning and exploration.

A supportive environment in which different ideas can be tried out and experimented with, with no negative consequences. On the contrary, it is common that one good idea leads to another.

The LEGO® System grows with the person, from the youngest child to the grown-up adult user

The LEGO System also grows *beyond* the person: at all levels of engagement with LEGO, from Duplo® to the world of the Adult Fan of LEGO, the LEGO System is a social tool, fostering connection and collaboration.



Using Pidwirny's definition of a system to explain the nature of the LEGO System of Play

In Chapter 3 we saw Pidwirny's list of eight features that characterise a system. These connect directly with the LEGO System as follows:

1. Systems have a ***structure*** that is defined by its parts and processes.

The LEGO System has a physical structure that is absolutely clear: the studs and tubes that interconnect, the mathematical system of measurements that underpins the LEGO building system, enabling a huge range of different pieces to connect in an almost infinite number of ways, not only within the standard LEGO System but also across Duplo® and Technic®.

The LEGO System is also constituted by a set of less tangible ideas and processes which were listed in the section above, 'The philosophy of the LEGO System'.

2. Systems are ***generalizations*** of ***reality***.

The LEGO build system can capture the essence of any object, natural or man-made, but in the somewhat simplified LEGO form. It can also be used to represent abstract concepts, feelings or ideas, in metaphorical form. LEGO bricks offer a 'pixelated' reality, where building components and their countless combinations can offer sophisticated models of realistic and imaginary concepts, but featuring the very recognisable 'LEGOised' feel. The LEGO system therefore enables a generalisation of reality with an identity of its very own.

3.Systems tend to ***function*** in the same way. This involves the **inputs** and **outputs** of ***material*** (***energy*** and/or ***matter***)

that is then processed causing it to change in some way. In the case of the LEGO® System we

talk about low floor, high ceiling and wide walls, meaning that the systems have an inherent logic to them, and this logic creates a low threshold for initial exploration in that grabbing and putting together is what children do naturally as part of exploring the world. Furthermore in more complex offers (higher ceiling) like WeDo and LEGO® Mindstorms, input and output are controlled through programming as an evolution to the direct control used with the physical building system. The wide walls pertain to the fact that a wide range of conceptual spaces can be explored with the same building system and even though the area being explored may yet be unknown to the child, the behaviour of the building system is not.

Much like the systems of science channel creativity in particular directions, towards specific questions and the systems of art forms, such as music or oil painting, enable the creative individual to explore different answers to a question — The LEGO System has something in common with both of these. It can offer the tools through which a problem can be solved (how to transport an apple from A to B, or how to bridge a stream), or can offer a palette of opportunity for open creative expression (building a fantasy creature, spaceship or landscape; or, as in LEGO Serious Play, creating metaphors to represent feelings or identities).

4. The various parts of a system have ***functional*** as well as ***structural relationships*** between each other.

The LEGO System has a strong integration of function and structure: the structures of the system fit together and they work *because* they fit together. LEGO bricks offer a rich repertoire of patterned elements (parts and connectors), the 'constraints' of which (a visual-tactile language with an internal logic) help sustain mindful engagement through playful exploration. Many generic parts together form meaningful structures.

5. The fact that functional relationships exist between the parts suggests the ***flow***

"LEGO offers the tools by which a problem can be solved and an open palette for building meta-phors to express feelings and identities"

and ***transfer*** of some type of ***energy*** and/or ***matter***.

In the LEGO System, complex cause and effect relationships can be built from the ground up by the relatively simple act of combining individual elements. In a concrete sense, force and velocity can be transfered either directly or indirectly. At the level of ideas and knowledge, the LEGO System enables the flow and transfer of a person or group's creative ideas into physical constructions. Furthermore, in the work of LEGO Serious Play we have seen that the LEGO System can facilitate the flow and transfer of impressions, emotions and strategies, at both an individual and collaborative level, enabling people to see connections and using the LEGO® System to help other workplace or organisational systems flow better.

6. Systems often exchange energy and/or matter beyond their defined boundary with the outside environment, and other systems, through various **input** and **output** processes.

In many ways, the LEGO System is a self-contained system, and this is part of its appeal. However in the real world of children's play, LEGO products sit within the context of play spaces filled with other toys and equipment, and naturally interacts with that environment. In the world of Adult Fans of LEGO (AFOLs), LEGO elements are often 'hacked' together with other materials to make unusual tools, toys or machines. See for example:

LEGO minifigures hacked with LEDs for Halloween
http://www.evilmadscientist.com/article.php/LEDMinifigs

The LEGO USB stick and LEGO MP3 player
http://www.instructables.com/id/LEGO®-USB-Stick
http://www.instructables.com/id/Building-a-LEGO®-MP3-Player

A LEGO computer
http://home.hawaii.rr.com/chowfamily/LEGO®

A LEGO harpsichord
http://www.henrylim.org/Harpsichord.html

In LEGO Serious Play, there is an exchange across the boundaries of LEGO play and the workplace, connecting ideas that come from the experience of being creative and expressing ideas using LEGO, and the experiences of strategic problems and solutions in the real world.

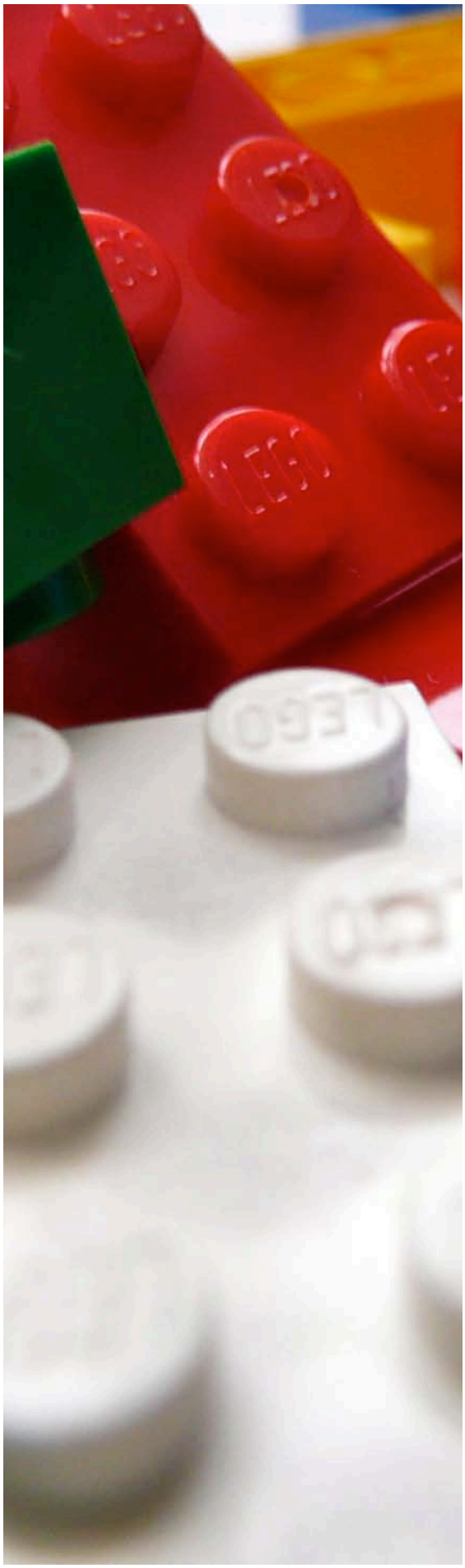
7. Functional relationships can only occur because of the presence of a ***driving force***.

The driving force in the LEGO System is always the creativity of human beings – children and adults who are empowered by the LEGO System to connect, construct, contemplate, and continue.

8. The parts that make up a system show some degree of ***integration*** — in other words the parts work well together.

This is the physical basis of the LEGO System – a set of parts which do not simply 'work well together', but which are

"In the LEGO System, complex cause-and-effect relationships can be built from the ground up by the relatively simple act of combining individual elements"



The eight qualities of strong learners show the benefits of playing with LEGO® Systems

In chapter four we saw Guy Claxton's list of eight qualities or dispositions which describe a powerful learner. These map onto the LEGO® System as follows:

1. Curiosity

As we saw in the discussion of 'Give the mind a hand, and the hand a system,' above, the LEGO System encourages curiosity about the world in a hands-on way. The simple but often surprising way in which LEGO bricks fit together within the system means that we could say that the system 'naturally' lends itself towards fostering curiosity and material engagement. When supported by a classroom, workshop or family situation which encourages inquisitiveness and exploration, the positive impact is amplified.

2. Courage

Having courage means being willing to take 'risks' and to learn from mistakes that may arise, rather than being knocked back by them.In his studies of children playing with the LOGO programming language, Papert claimed that the activity fostered skills of analysis and constructive self-criticism, meaning that the children would learn to analyse their own thinking as a matter of course, and gain self-confidence both to make mistakes and to correct them. However, despite excellent results reported with severly disabled children, some research suggests that this self-confidence does not generalise to other sorts of thinking in the way that LOGO-proponents assumed they would.

Dweck's research on mindsets would suggest that the benefits of playing with LEGO products on their own may not be enough to ensure that the skills of analysis and constructive self-criticism will spontaneously translate to other parts of children's lives, but that if they were reinforced by positive support from parents and carers – emphasising a growth mindset when children encounter building

challenges – then this will aid the positive effect of playing with the LEGO System, and would help explain some of the benefits that LEGO parents have reported from their children playing with LEGO products.

This social view of creativity and risk-taking is supported by Ken Robinson, who argues that children are born with risk-taking creative impulses but that these are usually knocked out of them by parents, other adults, and especially schools. He says:

> Kids will take a chance. If they don't know, they'll have a go... They're not frightened of being wrong. Now, I don't mean to say that being wrong is the same thing as being creative. What we do know is, if you're not prepared to be wrong, you'll never come up with anything original. And by the time they get to be adults, most kids have lost that capacity. They have become frightened of being wrong.
>
> And we run our companies like this, we stigmatize mistakes. And we're now running national education systems where mistakes are the worst thing you can make. And the result is, we are educating people out of their creative capacities.
>
> Picasso once said this, he said that all children are born artists. The problem is to remain an artist as we grow up... We don't grow into creativity, we grow out of it. Or rather we get educated out of it[100].

Clearly the courage to play, experiment, and get things wrong is an important one. LEGO® play may not 'create' courageous learners in itself, but in a supportive environment may encourage exactly this kind of creative resilience.

3. Exploration and investigation

The LEGO System encourages the activity of exploring and finding things out. As mentioned above, the system has 'low floor, high ceiling and wide walls', meaning that it is easy to begin using the system, but that LEGO building can be taken on to very complex and sophisticated levels, and to explore a wide range of conceptual spaces. As with curiosity, the LEGO System has a built-in tendency to support investigative and exploratory play, and within a supportive environment can play a role in developing these capacities in children and adults.

4. Experimentation

The LEGO System offers a safe environment in which a person can build, change, fiddle and experiment until they achieve the desired result by finding the potential or the meaning within the thing they are working on. This fits alongside the themes of courage (to take risks and see what works, and what doesn't), curiosity and exploration.

5. Imagination

The LEGO System has always been seen as a way of unlocking the child's imagination. (The same applies to adults). The LEGO System is obviously an incredibly open system – there are infinite possibilites to what can be built, and the manner and style in which that thing is built. It lends itself to role play, asking what if as well as and imagining what could be.

6. Reason and discipline

The LEGO System aligns the freedom of almost infinite creativity with a clear and fixed logical structure in the interlocking components. It therefore unites the aesthetic and artistic dimension with reason and discipline. When the system is used in a supportive educational context it can encourage critical thinking and evaluation. One of the strongest propositions of the LEGO® build system is its ability to encourage children and adults alike to adopt

100 Robinson, Ken (2006), presentation at Technology, Entertainment, Design conference, Monterey, CA. http://blog.ted.com/2006/06/sir–ken–robinso.php

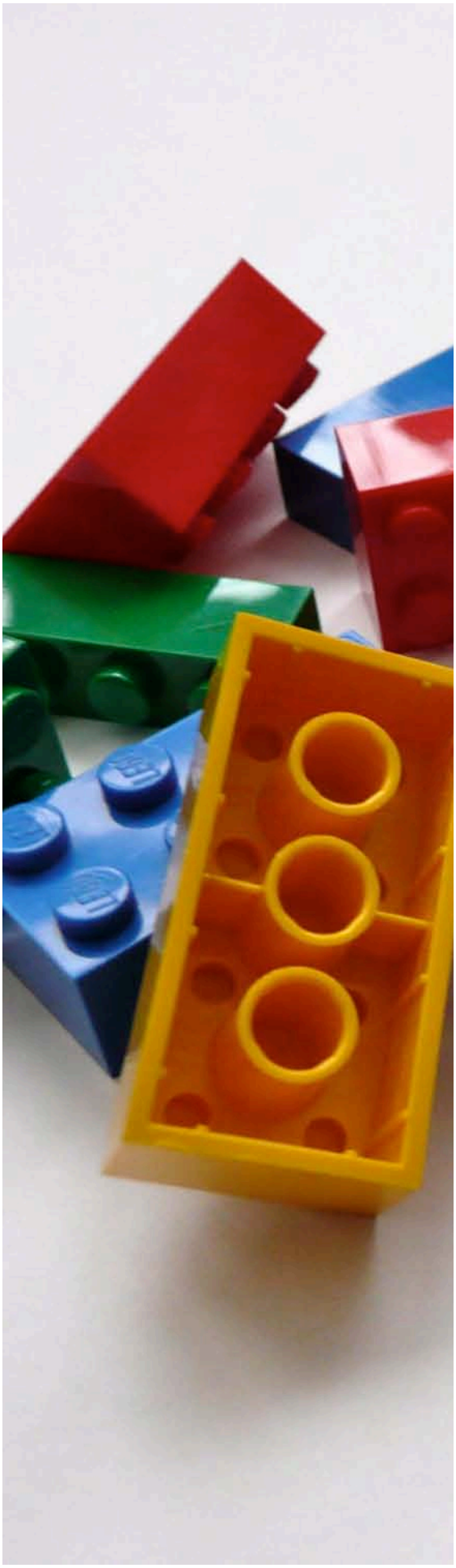
a growth mindset – developing skills and creativity through 'hard fun'.

7. Sociability
The LEGO System is a system to share with. It empowers the individual to explore their own creative expression, and moreover in recent years has gained legitimacy as a creative domain in its own right through the vast community of fans of all ages. The fans use the Internet and fan events to convene socially, bringing the 'field' around the LEGO® System of Play to life by continuously contributing, commenting, evaluating and appreciating submissions to the vast domain of LEGO creations.

Equally, this growing social dimension around LEGO bricks as a creative medium also caters for both the individualist and collectivist ideals of creativity by celebrating both individual and group builds. Many of the most spectacular LEGO creations are the result of group creativity and group building efforts, much like the creation of computer games and software applications demands a cast of thousands to design, program and test the end product. Increasingly, even in the LEGO domain, the 'connective' kind of creativity is becoming visible, where fans share builds with one another as a conversation and the model keeps evolving through the input of the fan community.

8. Reflection
Finally, the LEGO System is a system to think with. It encourages the process of making and reflecting, then making and reflecting again, in a thoughtful circuit of activity. In LEGO Serious Play participants are encouraged to build quickly and spontaneously, but then to 'take a step back' and consider what they have made, and then review and change it as they see fit, with multiple iterations of individual and the collective activity. This build-then-reflect approach is really just one of the standard ways of using LEGO® which people naturally adopt.

These eight qualities show the range of ways in which the LEGO System fosters personal growth and dynamic thinking. Crucially, these skills are those which are seen by forward-thinking experts as crucial to employability in the twenty-first century.



The role of the LEGO® System in supporting the creative process and mindsets behind systematic creativity

1. Preparation: becoming immersed in —and sensitive to—problematic issues that are interesting and arouse curiosity.

Mindset: **Curiosity** Curiosity fuels learning, drives individuals to ask questions, and wonder how things work. Curiosity coupled with playfulness means enchantment becomes a lever to grow an thrive – ask what if as well as imagine what could be.

The LEGO System encourages curiosity about the world in a hands-on way. The simple but often surprising way in which LEGO bricks fit together within the system means that we could say that the system 'naturally' lends itself towards fostering curiosity and material engagement. When supported by a classroom, workshop or family situation which encourages inquisitiveness and exploration, the positive impact is amplified.

2. Incubation: ideas churn around below the threshold of consciousness.

Mindset: **Mental readiness** Mental readiness has everything to do with being focused, persistent, and fully committed to act on our intentions. When being playfully receptive, inward and solitary and in a state of relaxation and alertness, we are in the optimal mood for good ideas to emerge and propel the incubation phase on towards insight.

The LEGO System has always been seen as a way of unlocking the child's imagination. (The same applies to adults). The LEGO System is obviously incredibly open — there are infinite possibilites to what can be built, and the manner and style in which that thing is built. It lends itself to role play, asking what if as well as and imagining what could

be and to the LEGO Serious Play statement as mentioned before “if you build, it will come’.

3. Insight: the "Aha!" moment when things suddenly fall into place

Mindset: **Confidence** Being confident has a big impact on our ability to tolerate uncertainty, be open-minded, take risks, engage in questioning, be patient, defer judgement, be resilient and show empathy, habits that are all key to being creative.

The LEGO System offers a safe environment in which a person can build, change, fiddle and experiment until they achieve the desired result by finding the potential or the meaning within the thing they are working on. This fits alongside the themes of courage (to take risks and see what works, and what doesn’t), curiosity and exploration.

4. Evaluation: deciding if and insight is valuable and worth pursuing.

Mindset: **Positive framing** Evaluation is in itself a critical phase of the creative process, as we hold our ideas up to the light to determine whether they are valuable to us or not, and by being able to positively frame the situation helps us embark on the hard graft of improving the idea rather than giving up.

The LEGO® System aligns the freedom of almost infinite creativity with a clear and fixed logical structure in the interlocking components. It therefore unites the aesthetic and artistic dimension with reason and discipline. When the system is used in a supportive educational context it can encourage critical thinking and evaluation. One of the strongest propositions of the LEGO build system is its ability to encourage children and adults alike to adopt a growth mindset – developing skills and creativity through ‘hard fun’.

5. Elaboration translating valued insights into a final form.[101]

Mindset: **Commitment** Commitment is essential in enabling the perseverance often required when working with an idea – the ultimate value of the idea is often the product of how well the idea has been elaborated, making the value of the idea or artefact more obvious. To be able to sustain the energy to do this, commitment requires a positive vision of where we want to go and a heartfelt reason for doing it and the determination to pursue that vision.

The LEGO System is a system to think with. It encourages the process of making and reflecting, then making and reflecting again, in a thoughtful circuit of activity. In LEGO Serious Play participants are encouraged to build quickly and spontaneously, but then to ‘take a step back’ and consider what they have made, and then review and change it as they see fit, with multiple iterations of individual and the collective activity. This build-then-reflect approach is really just one of the standard ways of using LEGO bricks which people naturally adopt.

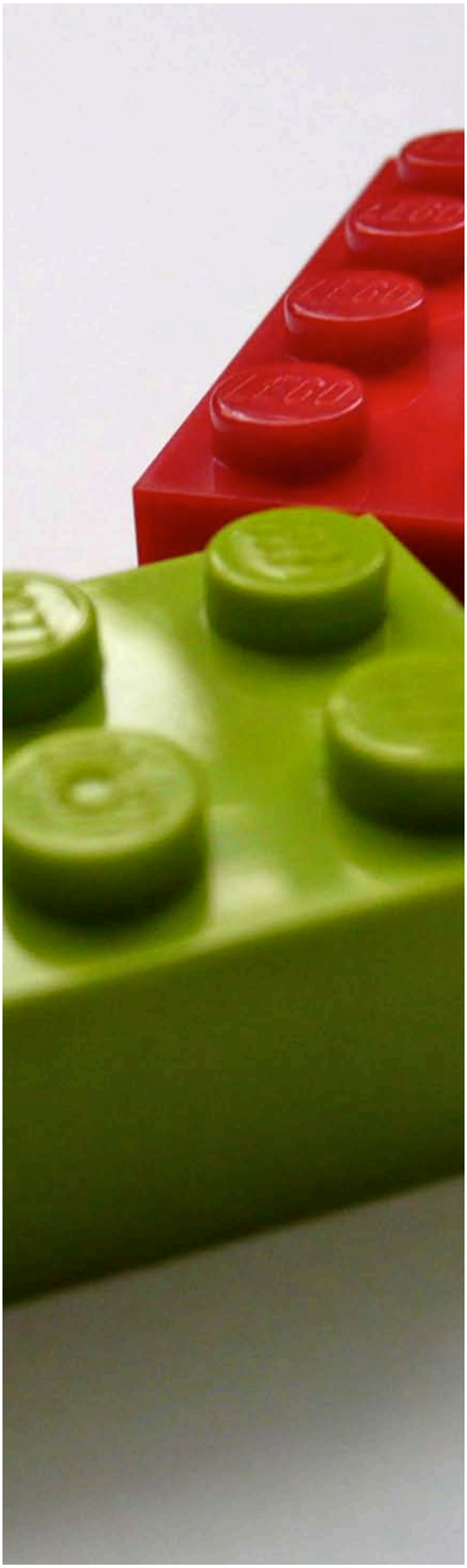
Both the examples of LEGO use, whether in supporting powerful learners, or indeed in the creative process, shows how the LEGO System by virtue of its versatility not only enables construction of knowledge and a tool that supports different phases of the creative process – it appears that its unique

101 Csikszentmihalyi, *Flow,* p. 79.

value lies in assisting us to turn the creative process upside down:

> Instead of identifying a problem and then seeking solutions, Boyd suggests turning the process around: Break down successful products and processes into separate components, then study those parts to find other potential uses. This process of "systematic inventive thinking," which evolved from the work of the Russian engineer and scientist Genrich Altshuller, creates "pre-inventive" ideas that then can be expanded into innovations.[102]

102 http://www.iht.com/articles/2008/12/07/business/innovate.php?page=1 Accessed 9th December 2008



Using systems in problem-solving

Genrich Altshuller, the developer of the Theory of Inventive Problem-Solving and the accompanying ARIZ (Russian acronym for Algorithm for Inventive Problem-solving), firmly believed that, since people can be trained to become doctors and musicians, they can also be trained to be innovative. Analysing huge quantities of available data on global patents, Altshuller identified consistent patterns of invention and technological evolution that can potentially be used across all areas of science and technology.

The thinking behind TRIZ and ARIZ is that at the root of most technical problems are contradictions that have been successfully solved in other industries and that by drawing upon this knowledge, we can solve any problem. The algorithmic methodology considers the process of solving inventive problems as a sequential action to define more accurately – and solve – technical contradictions. The thinking process is directed toward an ideal method, or an ideal device. The systematic approach is used in all stages of the solution process[103].

ARIZ lends itself well to problem-solving in the fields of technology and engineering, and the approach is an interesting example of how systems are not only useful in constructing knowledge and expressing ideas, but can also be useful when working with complex problems – encouraging us to adopt systems thinking in order to solve them.

Paraphrasing Toru Nagakawa's definition of TRIZ:

> Technical systems evolve towards increasing ideality by overcoming contradictions by a minimal introduction of resources. Thus, for creative problem solving, it helps to understand the problem as a system, to image the ideal solution first, and then to resolve the contradictions.[104]

103 Altshuller, *The Innovation Algorithm.*

104 Toru Nakagawa: "Approaches to Application of TRIZ in Japan", TRIZCON2000: The Second Annual AI TRIZ Conference, Apr. 30 - May 2, 2000, Nashua, NH, USA, pp. 21-35. ; TRIZ Home Page in Japan, May 2000 (in English), Feb. 2001 (in Japanese).

Any system is composed of a number of components and their relationships and may be regarded as a subsystem of its super-systems. Evolution can be viewed universally as progress towards becoming more ideal. The evolution occurs only "by over-coming contradictions". Contradictions appear first as the gaps between what people would like something to do, as opposed to what it actually does. Such contradictions, once recognized as obstacles/barriers, are compromised somehow for a while, and are then overcome by break-through inventions; examples include Apple's provision of iTunes to make the system of adding music to your iPod more effortless.

For creative problem solving to occur, one first needs to see the problem itself as a hierarchical system of problems. In order to focus our problem solving efforts we need to imagine the ideal solution, and then try to find the ways of achieving it, for example by back-tracking to the present situation step-by-step. It may appear backward, yet is far more effective than the conventional way of using trial-and-error, hoping you might stumble on the right solution.

To creatively solve the contradiction one needs to reformulate the problem as Physical Contradiction, i.e. breaking the problem down to the smallest constituent parts (for instance a situation where an aspect of a system is requested in one direction and in its opposite direction at the same time) and attempt solving it with the Separation principle for instance, i.e. can the contradiction be overcome by introducing a separation in space, time, upon condition, or between parts and the whole.

Interestingly, as the TRIZ example shows – the ability to solve problems by imagining them as systems of constituent parts, and actively using curiosity (asking what if?) as well as playfully imagining what could be, in order to overcome the contradictions – become cornerstones in solving problems systematically. Engaging with the LEGO® System, one can in effect play one's way into an intuitive understanding of algorithmic problem-solving as for instance; all aspects of the separation principle can be replicated using the LEGO build system.

"For creative problem-solving to occur, one first needs to see the problem itself as a hierarchical system of problems… engaging with the LEGO System, one can in effect play one's way into an intuitive understanding of algorithmic problem-solving"

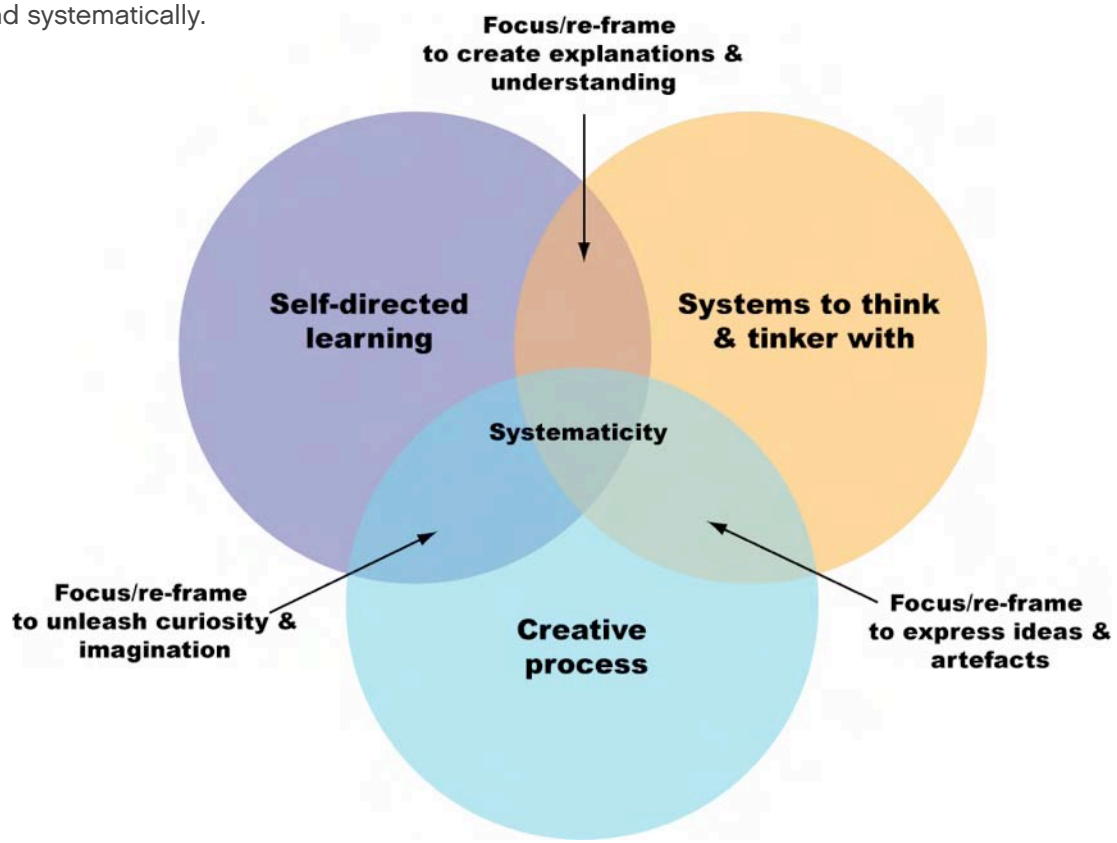
Systematicity at the intersection of Creativity and Learning

As illustrated in the thinking behind the Theory of Inventive Problem Solving, the importance of systems in creative problem-solving is crucial. Systems are at the heart of the process of both problem-solving as well as problem-setting, and the ability to understand problems as systems in their own right is essential for being able to solve them creatively.

Learning and creativity both involve hands-on (tinkering), heads-in (reflection), and tools to tinker with (things, textures, patterns). Both require sustained interest over time, bring about new ways of thinking, or looking at the world, and call for certain qualities of the mind to function optimally. The differences between the two are subtle and lay in the ways of "getting ready", in the tolerance for - and manners of handling – surprises and uncertainties, and in the willingness and abilities to question established assumptions that have been working so far.

The LEGO Group defines construction play as "when, through play, the child creates or build something using materials. Construction play includes realizing an idea or a strategy in relation to the possibilities inherent in the materials used. Construction includes stacking, making an exact copy, shaping (in both soft and hard materials) but also by sampling (getting to know something through experimentation, testing in order to experience). Construction play is all construction / destruction and reconstruction.

Systems such as the LEGO® System of Play are particularly valuable as it can not only channel creative expression as well as become the tool to investigate the problem. In a learning context the System yields itself to creating explanations and understanding, constructing knowledge and by virtue of allowing that, helping to fuel the creative process further. Thus the LEGO System of Play and its quality of supporting both scientific and artistic kinds of creativity, emerge as the key enabling these two processes to interlock and fuel each other cyclically and systematically.



LEGO® Serious Play demonstrates how the LEGO System brings together learning and creativity

LEGO Serious Play, the consultancy process for businesses and organisations, offers a system through which the creativity of individuals can be channelled to reveal new meanings and insights. The LEGO Serious Play process is not really an alternative or entirely original use of the LEGO System: rather, it *is* the LEGO System, developed into a facilitator-led consultancy process for adults.

The roots of the LEGO Serious Play process in the LEGO System can be seen in the story of how the process came to be developed. In 1996–97, Kjeld Kirk Kristiansen, then CEO and president of the LEGO Group, was concerned his staff weren't contributing their imagination and creativity to imaginative strategies for the future of the company. During this time, he had discussions with Bart Victor and Johan Roos, both professors and consultants from the Swiss business school IMD, who had seen this kind of situation elsewhere. Together they realised that a solution might be found in the LEGO System itself: just as the LEGO Group had been telling children to 'build their dreams' for decades, so perhaps adults could be asked to build their visions for future strategy[105].

Whilst more conventional consultancy interventions are based on the notion that an external 'expert' needs to be brought in to identify problems, and to propose solutions, LEGO Serious Play begins with the assumption that the answers 'are already in the room'. This obviously connects with the inclusive and participatory nature of the LEGO System in general.

Rather than asking participants to build *literal* models of their workplaces and problems, the process uses the idea that everything should be built in *metaphor* and that participants share their 'stories', listen and collaborate. The process of connect – construct – contemplate – continue – describes the circuit of building, reflecting and

105 Much of this material on LEGO® Serious Play is from David Gauntlett, *Creative Explorations: New approaches to identities and audiences*, Routledge, London, 2007.

communicating, and collaboration, which is at the heart of LEGO Serious Play. This means that it is easy for participants, even those with limited experience of LEGO, to make meaningful constructions. Like any LEGO experience, LEGO Serious Play works best in a non-judgemental, free-thinking – and therefore playful –environment.

Every participant gets an equal opportunity to express their feelings or ideas, through LEGO building, and the collaborative process means that each individual's contribution builds upon that of their colleagues to achieve a shared vision contained within a group-built LEGO construction[106].

Just as the LEGO System is an enabler of play, LEGO Serious Play makes use of the notion that adults can benefit from engaging in play. In LEGO Serious Play, the notion of play is employed as follows:

> We define play as a limited, structured, and voluntary activity that involves the imaginary. That is, it is an activity limited in time and space, structured by rules, conventions, or agreements among the players, uncoerced by authority figures, and drawing on elements of fantasy and creative imagination[107].

It can be noted that this model of play is basically the same as that enabled, for children and adults alike, by the LEGO® System in general. The purpose of the process in the business context is to enhance social bonding, emotional expression, cognitive development, and constructive competition[108].

It is argued that play is good for social bonding, as players have to collaborate and communicate; that it engages the emotions within a contained zone, where particular issues can be worked through; and that it fosters understanding between participants (Plato said 'You can learn more about a person in an hour of play than in a year of conversation'). Finally, the idea of 'constructive competition' is not that anyone is concerned about 'winning', but rather that participants are encouraged to do their best when they can see that others are doing so.

LEGO Serious Play, then, displays all the virtues of the LEGO System. It is creative, enabling, and open. It does not set any path for the individual or group to follow, but rather embraces and supports any ideas that may emerge, and encourages development and collaboration to make these stronger. Every stage of the LEGO Serious Play process involves building with LEGO bricks, utilising the 'hand-mind connection': there is never a point where participants merely sit back and write down, or chat about, the issues without building their response first. Therefore everything that is discussed comes from out of the building process, where the hand and mind engage to give visual, metaphorical shape to meaningful things, emotions, and relationships.

106 This finding comes from the research conducted with several diverse groups of individuals which is published as David Gauntlett, *Creative Explorations: New approaches to identities and audiences*, Routledge, London, 2007.

107 LEGO Group, *The Science of LEGO® Serious Play*', The LEGO Group, Billund, 2004.

108 LEGO Group, *The Science of LEGO® Serious Play*', The LEGO Group, Billund, 2004.

Defining Systematic Creativity

Systematic creativity is therefore a concept which not only encapsulates a particular way of engaging our faculties, but also doing it methodically, as opposed to randomly, and furthermore, coupled with a system that supports both, it can link creativity and learning in a re-inforcing cycle, forming the basis for innovation.

In its simplest form Systematic Creativity is about using logic and reasoning along with creativity and imagination, to generate ideas or artefacts that are new, surprising and valuable.

By fostering the relevant mindsets behind the creative process (curiosity, mental readiness, confidence, positive framing and commitment) it is possible for individuals to become self-directed in their creativity and begin engaging it methodically, rather than randomly, creating the conditions for Flow to occur. Hence it is also about deliberately pursuing a balance between challenge and ability, as well as between stability and change in order to create optimal conditions for self-directed learning and creativity.

Self-directed learning and creativity can become cyclical and self-reinforcing (systematic) in the presence of a system that supports both. The LEGO® System is one of the few systems capable of channeling two usually opposing kinds of creativity: the science-kind of creativity directed towards solving specific questions; (how to transport an apple from A to B, or how to bridge a stream), and the artistic-kind of creativity directed towards open creative expression (building a fantasy creature, spaceship or landscape; or, as in LEGO Serious Play, creating metaphors to represent feelings or identities).

With LEGO products we learn how knowledge can actively be created and transformed by creative manipulation of systems, through maaking things (build/create), imagining what could be, acting/doing as if and through story-telling we become familiar with inventive, algorithmic problem-solving through the act of play.

By learning to give shape and form to our imagination, by constructing and externalising concepts, making them tangible and shareable, we can not only reflect on them ourselves but invite others to reflect with us, allowing us to learn from both. This enables us to begin creating things that are new, surprising and valuable to us as individuals (being creative), but perhaps also to others — which is innovation.

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