

# The Literacy of Creativity

## -The Emergent Dynamics Beyond Expectations-

**Masatoshi Murase<sup>1</sup> and Paul G. Mezey<sup>1,2,3,4</sup>**

<sup>1</sup>International Research Unit of Advanced Future Studies, and Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto 606-8502, Japan  
<http://www2.yukawa.kyoto-u.ac.jp/~future/?lang=en>,  
E-mail: [murase@yukawa.kyoto-u.ac.jp](mailto:murase@yukawa.kyoto-u.ac.jp)

<sup>2</sup> Canada Research Chair, Tier 1, 2003-2017, Scientific Modelling and Simulation  
Department of Chemistry and Department of Physics,  
Memorial University of Newfoundland, St. John's, NL, CANADA

<sup>3</sup> Institute of Chemistry, Eötvös University of Budapest  
Budapest, Hungary, Tel. 00 36 30 25 30 820

<sup>4</sup> Faculty of Chemistry and Chemical Engineering, Babes-Bolyai University,  
11 Arany Janos st., RO-400028, Cluj-Napoca, Romania  
E-mail: [paul.mezey@gmail.com](mailto:paul.mezey@gmail.com)

**Abstract.** Creativity is a major component in many of the aspects of our usual lives, and on a broader scale, creativity does enhance human evolution and then the resultant changes could enhance the cultural and scientific evolution. Creativity, in an even more generalized sense and not restricted to human activities, can be considered as a feature of unexpected development that is triggered by a sudden match of the given stage of a developmental process with a forward directing solution that is not formally following from the characteristics of the development itself, but utilizes some seemingly unexplained occurrences. In this more general sense, an abstract variant of creativity can be associated with nature and evolution, as well as with innovative solutions to problems facing humans. Creativity should be therefore considered as the emergent dynamics throughout history. Some features of creativity are discussed in the context of literacy.

**Keywords:** Creativity, Emergent Dynamics, Paradox, Education, Transfer

## **1. Introduction**

Creativity may be considered a factor in developments on many levels. In the everyday language, creativity is associated with somewhat surprising and intuitively perceived ideas of humans, yet, on a broader basis, creativity is a solution-finding process fundamentally different from earlier ones, that can be, for example, the “Creativity of Mother Nature” in some natural phenomena, and even in the processes of pre-human evolution on Earth.

### **1.1. Aspects of creativity**

Aspects of creativity had major roles in developing the skills of survival of early humans not particularly advantaged in some physical characteristics relative to animals competing for the same habitat. Creativity was needed for individual survival, for group survival, for food acquisition and later for food generation, including the more recent approaches to agriculture. Later, creativity was the crucial ingredient in technological developments (involving, of course, technologies used in warfare ...), cultural developments in the arts and society in general.

Yet, because of its very special, somewhat elusive nature, creativity of humans is an intellectual trait that is difficult to transfer by the usual channels of education. Creativity is not the main target for education nor transference, it acts as *emergent dynamics*, often beyond anyone’s expectations. Instead of education or teaching, a generalized version of play, with emphasis on freedom of thoughts, must be an essential contribution to creativity. We therefore probably need a strong paradigm shift for recognizing how creativity is understood and how the skills of creativity can be attempted to be transferred to others, or perhaps, relying on a more likely process, nurtured in others.

In this contribution, we are discussing some aspects of this very problem: the recognition, perception, awareness, and the various levels of successes in understanding the skills required in the development of creativity, with emphasis on the crucial role of examples, play, and on the Literacy of Creativity.

### **1.2. Paradox as the mother of creativity**

Paradox must be the mother of creativity. Conflicting ideas, and paradoxical aspects of developments often were the triggering factors for human activities which could be recognized as creative: “The need leads to inventions”. However, paradoxes also have some seemingly disturbing qualities, often regarded as difficulties which are shaking up the usual belief systems and the usual approaches to problem solving as they are considered in the given period of human cultural and scientific development. For example, the traditional scientific ways of thinking, typical in many periods of *Western Science*, often have tried to get rid of paradoxes, a characteristic trait throughout history.

Some of these difficulties have been connected to the approach, where the distinction and conceptual separation between an observing subject and an observed object have been strictly assumed. Also, we might often feel the need to provide a single, general solution to the same type of problems, and thus we have little thought given to the possibility that there might be almost infinitely many solutions to such a range of problems. In many instances, we have tried to think about creativity very intensively in order to “create” new methods, new materials, or new solutions to the given problems, however, such an approach is only seldom successful.

Unfortunately, such direct, “forced” approaches and general attitudes are usually not good enough to “create” creativity, as creativity is the emergent dynamics, often beyond our usual expectations. What we may need instead is not a rigid focus on the problem, rather, we should broaden our perspective, allowing a seemingly random flow of thoughts to occur, almost recalling a childhood feeling of enjoying our life by playing freely, and, actually enjoying so many things at once. This broadening of focus, a “fuzzification of focus”, when we are trying to solve a specific problem may seem to be a “paradox”, but here we may have some far broader range of possibilities how we could be more creative.

We should not think that creativity could be educated through some highly structured teaching methods of teachers, but we should consider that creativity could be emerging through our own play

and even “whimsical” ideas beyond our fully controlled and directed thoughts. In this sense, if we think of creativity within a group of humans dedicated to a given problem, language-based communication could possibly be not good enough, and in some cases, such language-based communication could even be causing some rigidity in directing and restricting the thoughts of others in the group.

### **1.3. Nature as the origin of creativity**

Nature itself is full of objects, features, living creatures, and processes, which are valid, yet they may be perceived as paradoxical, and in this way, they may also motivate creativity. We should learn how complex situations evolve, not only involving creativity and paradox, but also involving, on the levels of details, even fractal-like features (self-nested hierarchy). It can be instructive to study how such complexities develop through the evolutionary history, because nature itself is the origin of creativity.

Paradoxically, difficulties are often the triggering factors for creativity. In the following segment of this report we shall have more focus on two historical examples of exceptional creativity, the introduction of the Law of Gravity by Isaac Newton in 1666 (Newton, 1687), and the introduction of the alternate current by Nicola Tesla in 1912 (Tesla, 1888, Tesla 2007), without which our life standards of today would be utterly impossible.

Here we shall only remark that major difficulties in that period of Newton’s life probably had major motivating effect on his creativity: the plague raging in England, that has effectively confined him in the house of his mother. The difficulties caused by the plague, as well as a strong focus on examples and analogies, had important contributions to his discoveries. In the case of our second example, for Nikola Tesla, family tragedies and less-than-fair treatment by his American employers represented major difficulties, yet, his keen sense of analogies served his creativity well. Even in very specific fields of more recent studies, analogies often provide the means to solve problems, for example, the recognition of analogies between muscle contraction and nerve excitation has been the source of useful developments (Murase, 1992).

A paradoxical abandoning of reality can also be useful in some mathematical manipulations if these paradoxical aspects are kept in mind, such as proving a three-dimensional property of real molecules by an abstract, four-dimensional model, specifically, proving the Holographic Electron Density Theorem: any small positive volume part of a molecular electron density cloud contains the complete molecular information (Mezey, 1999).

Treating a three-dimensional problem in a four-dimensional abstract space appears as a paradoxical complication, however, this “dimension jumping” from 3 dimensions to 4 dimensions allows a precise and rigorous approach to the proof. Of course, such a “dimension-jumping” mathematical approach is not without precedent, as it is analogous to solving problems of one-dimensional real functions by moving out to the two-dimensional complex plane, a “dimension jump” from one to two.

## **2. The Various Levels of Difficulties and Constraints Enhancing the Chances for Creativity**

It is very revealing to recall most of the examples of the great advance of science where creativity has played a fundamental role. Here we shall focus only two such historical events, the first one is the great advances of science as pioneered by Newton (Newton, 1687).

The second example is the creative genius of a more recent time, the achievements of a person whose inventions are at the very basis of our everyday life today in most countries of the globe, whose results we do take for granted, without much acknowledgement, certainly nothing comparable to recognition given even to Hollywood actors, basketball players or TV anchors, yet, what a difference for humanity: the inventor of the alternate current for energy transfer, power stations, generators, transformers, electric engines, the power for the very lights in your home, and nearly all your household machinery: this creative genius was Nicola Tesla (Tesla, 1888, Tesla 2007).

### **2.1. Newton's great discoveries caused by natural difficulties**

What is remarkable, that most of Newton's greatest achievements, with huge contributions from exceptional creativity, have been coincident, and at least in part triggered by a very negative event: the plague reaching England, not much after he has completed his university education.

The plague has started in 1665 in England, the year Newton has received his diploma from Cambridge University, however, because of the slower rate of transportation, it has not spread as quickly as it is possible for a pandemic today. However, by 1666 (the year of the great London fire), Cambridge University has decided to close. This was relief for Newton from his very busy schedule with students and other administrative chores at the University, that kept him away from the science he wanted to do. He moved to his mother's house in Woolsthorpe, where his most spectacular discoveries were made, under the conditions of some level of confinement and difficulties due to the plague.

Among his exceptionally important discoveries of those times one can name the following:

Law of Gravity (the same law governs the motion of planets and the falling apple),

Differential Calculus (today, we give also credit to Leibniz), and

Spectral Resolution (white light is a combination of all colors, and if all the color beams are united, white light is obtained again).

Creativity in his case resulted from several sources: of course, his exceptional intelligence was a fundamental factor, however, the special circumstances caused by the plague epidemics, a great difficulty for the population of Europe of the time, have also contributed. A difficulty has created special circumstances for Newton, and these circumstances contributed to the fulfillment of his creative genius.

### **2.2. Tesla's creativity caused by "social" constraints**

Tesla had experiences of family tragedy when, as a young boy in Austro-Hungarian Serbia, he had to deal with the death of his brother, yet, he excelled in his studies, and very early recognized the huge advantages of the possibility of replacing the then dominant unidirectional electric current, (direct current), with a new type of electric current periodically changing directions, called alternate current. After emigrating to the US, he was working in the group of Edison, an advocate of the old direct current, hence he was a rival to Edison, and he felt there unappreciated and not well treated there. But these difficulties only strengthened his dedication and also contributed further to his creativity, leading to many additional inventions and patents, those of the transformer, still used today, a highly improved electric motor, still used today, the main components of today's radio and mobile phone communication (Marconi, in the first trans-Atlantic radio contact, in fact, used 17 of Tesla's patents), radio-controlled distant moving devices, etc.

Whereas in Tesla's case the initial difficulties were of different nature than those of Newton, these two examples show the general principles, that difficulties can greatly enhance the chances of finding creative solutions.

## **3. Higher Level Difficulties and Failures as Triggers for Creativity**

Whereas in the previous two examples the difficulties experienced by creative geniuses are not regarded as failures, only blocks towards their goals, yet, actual failures, even severe failures may also trigger creativity.

### **3.1 Learning from failure-Failure as an excellent teacher, for several reasons-**

The most immediate reason is that by experiencing a given failure, we certainly know, that the very steps we have made which have led to this failure are wrong, clearly, without any change, those steps are not advised to be repeated (except, perhaps, when circumstances change).

Also, a success is a happy event, there is nothing to worry about it, no need to analyze, it is just right, we are ready for the next event. By contrast, a failure is probably disturbing, occupies our minds more, and probably triggers more critical afterthoughts than a success. By generating many thoughts, while in a critical mood due to the failure, we probably learn something useful,

A failure often brings up more questions, than just those directly related to this failure; we might question a broader range of our assumptions, even our fundamental philosophy in some serious cases, so a failure may lead to a revision of far more than just the very problem at hand. This way, a failure may teach us more than just how to handle the same type of problems next time.

A somewhat light-hearted, but revealing quote, a rather famous one is recalled in the *Appendix*, a short conversation of just two sentences:

“We learn more from losing than we do from winning”,

“I guess that makes me the smartest person in the world”,

confirming the educational value of failures, perhaps in a somewhat exaggerated way.

### **3.2. Immunization by weak failures against big failures, help for future successes**

The danger of getting used to too many successes are significant: we are expecting success as “natural”, and if a failure happens, we are less equipped to deal with it. If we are fortunate, and failures occur in some less important areas, yet we can learn from them, this may be analogous to a vaccine, it may amount to some abstract “immunization against big failures”.

Another advice that may contribute to creativity is the following: “Prepare for failure and build on success”. Typically, failure may occur in many ways, many aspects of a process may go wrong, yet for a well-planned process, success is often interpreted rather narrowly, when only a specific outcome can be regarded as real success. Consequently, the preparations against failures often involve a rather wide range of precautions, a precaution against a multitude of eventualities, preparedness to overcome many possible mistakes, for many parts of the process to fail. This, by the very diversity of possible failures, often involves multiple events of creativity trying to counter many of those potential problems. On the other hand, if the process is successful as planned, this can be taken as a starting point for any future tasks, there is no need for fundamental changes, for learning new coping methods, and one may be able just to build on this success, one that has been learned already. Failure is more of a source of learning than success.

## **4. Pandemic as “Abstract Creativity by Nature”, Triggering Creativity in Responses by Society and by Science**

Whereas following the ideas of the previous section, a pandemic can be regarded as a failure of global proportions, a failure of the humanity’s established health-related safeguards, and a failure of containment of an epidemic within a local area of the Earth. This, as most failures, may be a source for new motivations and new conditions of creativity.

However, on an abstract level, one may also consider a pandemic as a novel, “creative” phenomenon by Nature, which is able to circumvent many of the earlier safeguards of humanity established internationally, specifically, the international safeguards introduced with the very purpose to prevent such pandemics.

As in most disasters, it is a natural human trait, that in our first reaction we may fall back to simple, old methods. This natural reaction, however, can also help for finding some creative solutions eventually. If in the next step, starting on such a simplistic basis, the more modern, advanced possibilities for responses are considered again, this newly formed duality of simplistic and advanced approaches may be the source of new recognitions, and new, creative ideas. When facing a task of solving an important problem whose initial reaction is different from the usual one, this may provide new ideas for creativity.

A pandemic may also contribute to a re-thinking of the priorities and the order of importance of our usual activities and preferences, when truly important questions are coming to the forefront: life, survival, compassion, care. Many of our presumptions, rooted in our relatively comfortable and technology-supported “everyday life” without pandemic, are no longer so central in importance, and there is a drastic reorganization of our priorities. In particular, the usually rather articulate self-interest promoting, news-worthy actions of some special interest groups do lose some of their usual appeals, as the focus of humanity is returning from some of the possibly utopistic luxuries to the elementary and fundamental questions of survival, with the natural laws of evolution taking a firmer hold again.

## **5. Creativity and the Role of Play**

It is unusual to attribute important role of light-hearted activities to serious scientific developments, yet creativity is often requiring an “easing up” of one’s mind, in order to allow a whole variety of seemingly unrelated mental influences to have effects on the actual thought processes.

One example is using analogies as freely as possible, since, by shifting thoughts from analogy to analogy, some of these analogies might trigger a brand-new idea as it is attempted to be applied to the original problem considered. Thus, the power of being aware of analogous problems, and recalling and testing them for possibly useful suggestions, is one important contribution to creativity. If such analogies, even seemingly distant and weak analogies are recalled, initially just in a playful way, without strict requirements for a “really good match” between the analogous problems, then this process might trigger a creative thought, useful for a possible solution for the problem at hand.

If in such an analogy there are just enough similarities to be worthwhile to play with the idea, this can already be beneficial: what would happen if the current problem could also behave like this, an apparently somewhat analogous problem?

In such, playful exercises, without the responsibility of “rigid, planned processes”, one may be able to discover far more features showing strong analogies and actual similarities than expected initially. As it often turns out, some of these analogies may possibly trigger new ideas worthwhile to test as possible approaches to solutions, that is, this initially playful attention to analogies might be triggering creativity.

## **6. How “Exceptions Strengthen the Rule”**

In some instances, a well-established and usually successful approach to solve to a given type of event may fail, and then the natural question arises, what went wrong? If we consider the usual approach to a solution being the “rule”, this exception to the rule is a noteworthy event, and this usually triggers a subsequent analysis. Well, the very fact that the established rule failed this time, does not yet make the rule stronger, however, such a subsequent analysis may reveal some special aspects, which may actually be incorporated in the rule, generating, in fact, a new, more advanced, and more effective rule. In this sense, indeed, the rule has become stronger, yes, the Exception Strengthened the Rule.

## **7. Difficulties with Educational Attempts to Enhance Future Creativity**

The Literacy aspects of creativity are different from those of more regular approaches to problem solving: from actual examples of well-recognized creativity it is difficult to compose into words and write down the essence of creativity, and, on the other hand, even if such attempts are made, reading out from such a description of the actual process of how such creativity has been born is also a tall order.

### **7.1. Learn to associate in a playful way**

It appears that creativity itself is not a skill that lends itself to simple educational methodologies. Of course, education is still crucial, but in a different way: education can be a source of a suitable, rich, and diverse background for knowledge, and this is a strong argument for general education, without the ever increasing emphasis on directed education, excluding many important features of general human knowledge and culture, including the culture of science.

Formal education may help the best if it provides a wide enough range of knowledge, possibly in fields completely unrelated, if the components of this knowledge can be recalled easily, even with only very superficial justification. If this recall process is suitable to remember and recall many analogies, possibly from quite different fields of studies than the field of the actual problem currently faced, then the chances are improved for finding a creativity-triggering analogy.

However, such processes are often regarded as a waste of time, and even discouraged, what we consider an unfortunate attitude. Indeed, playfulness, the often seemingly futile, but once-a-while highly rewarding “free-associations” (which are, of course, never truly free, only we are not fully aware of their mechanisms), do often lead to creativity.

### **7.2. Beginner’s luck**

Another interesting feature of education in the context of creativity is almost advocating “less formal knowledge of the actual problem, but high general level of education”. It happens often, that a person is exposed to a problem the first time, in a field that is not even on the list of topics this person is familiar with, and after some questions, needed for full understanding of the problem, a very creative idea of a possible solution occurs to this person. Often, such an event is regarded as “Beginner’s Luck”.

Yet, there is also another aspect, that has a somewhat paradoxical relation to education. Experts of the field of the given problem, are typically familiar with the earlier attempts to solve the problem, their mind is already within a framework of earlier approaches, their education has given them knowledge of those. However, their education, and their earlier thoughts about this problem, also constrain their thoughts, as their earlier acquired knowledge is, somewhat automatically, recalled, or, at least, this knowledge is there, “lurking in the background of their minds”. This knowledge might be a ballast, a burden for a truly novel approach to the problem. By contrast, a beginner, who has just understood the problem, but has only a fraction of this ballast, and who comes from the background of a mind trained in a very different field, is able to bring different analogies forward, which might be aiding a possible, creative discovery of a solution.

### **7.3. The benefits of the failure of education**

There are many examples of highly creative geniuses who had initially problems in elementary school education. Whereas no firm data are available for responsible generalizations, we assume that in those instances the initial education they have received have not provided one important contribution young minds need perhaps the most: stimulation.

If this early childhood experience has persisted, then it is safe to assume that the young child has developed some negative judgement concerning education, possibly contributing to a tendency to look for alternative ideas as compared to the “official”, education-approved ideas. Such a desire, to think differently, is probably a beneficial trait for creativity, but providing insufficient stimulation, is also a failure of the formal education. A failure that, in a roundabout way, contributed to some important, creative success.

In the case of those geniuses, this failure of education has been, at least partially, one of the origins of their creativity.

## 8. Appendix

As creativity and play are often connected, it is interesting to bring up a playful, but wise remark about the beneficial, motivating effects of failures. A failure may serve as an opportunity to re-evaluate the ideas, what is a truly beneficial action; a failure may provide a “running start” for a successful jump over a difficulty that may have seemed insurmountable earlier. The example is the statement of one of the characters of the comics series “Peanuts”, where the short conversation of Linus and Charlie Brown provides a reminder of an old wisdom (Schulz, 1968):

Linus: “We learn more from losing than we do from winning.”

Charlie Brown: “I guess that makes me the smartest person in the world”.

Sometimes, the words of wisdom are found in unexpected sources.

## 9. References

- Newton, I. *Philosophiae Naturalis Principia Mathematica ("the Principia")*, Royal Society, London, 1687
- Tesla, N. *A New System of Alternating Current Motors and Transformers*. Electrical World, 1888
- Tesla, N. *My Inventions: The Autobiography of Nikola Tesla*, Cosimo Classics Biography, 2007
- Murase, M. *Dynamics of Cellular Motility*, John Wiley, New York 1992
- Mezey, P. G. The Holographic Electron Density Theorem and Quantum Similarity Measures, *Mol. Phys.*, **96**, 169-178, 1999
- Schulz, C. M. *Peanuts Treasury*, Holt, Rinehart and Winston, New York, 1968