General methods to induce and enhance creativity among graduate students

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Abstract

This presentation sheds light on ten different methods that could be used with graduate students of any specialization in order to induce and enhance their creativity when doing research or when involved in socially responsible missions. The focus of this presentation is on computing and ontology, and all the elaborated examples cover different aspects of these two generic fields [1, 2]. However, as already mentioned, the presented ten methods are applicable across the complete plethora of scientific disciplines and could be used in any scientific research effort or any socially responsible activity. The methods covered are: Mendeleyevization (Inductor and Catalyst), Hybridization (Symbiosis and Synergy), Transdisciplinarization (Modification and Mutation), Remodeling (Granularization and Reparametrization), and Unorthodoxization (Top View and Bottom View).

1. Introduction

Proper education is the key for the economic and cultural well-being of a nation. Some young people decide to take only the basic education till the level of BSc while the others decide to approach the more advanced degrees, where the stress is on creative production of novel results that advance the state of the art in the field of focus. One gets born with potentials for creativity, but creativity could also be studied. Methods do exist that help induce creative thinking and/or enhance one's potentials for creativity. A set of such methods, universally applicable, is presented in this article.

2. Elaboration

2.1. Mendeleyevization

One first creates a classification of existing approaches to solve a problem. Classifications have leaves (if of the tree-like structure) or table elements (if of the two-dimensional structure) or points in a multi-dimensional space (if of a more elaborated structure). These "terminating-points" are treated as classes. If a class contains no examples from the open literature, chances are that such a class may contain novel solutions. One first has to check if solutions within such a class would make sense, and if yes, one has to search for a solution that would satisfy all the requirements of the given class, which is both of a better performance and possibly of a lower complexity. In some cases, the invention is possible only after a special construct is added in hardware or software (an inductor), or the invention is possible even without any add-on, but an add-on enables a lot better performance to be achieved. Numerous examples are available from the quoted references, from MISD computers to accelerated software architectures.

2.2. Hybridization

One selects two effective solutions and combines them. There are two general ways to combine them. The first approach, referred to as symbiosis, implies that two different solutions are employed in their complete forms. The assumption is that, under one set of conditions, the first solution performs better, and that under another set of conditions, the other solution is superior. An important add-on in this approach is a structure that does the estimation of work conditions, and selects the proper solution, and when conditions change, the other solution is activated. In this approach, the final performance is always equal or better than any of the two basic solutions, but the complexity is, in many cases, over two times higher than in any of the two basic solutions. In order to decrease the complexity with no or minimal decrease in performance, one can introduce an alternative approach, referred to as synergy. In that alternative approach, one decomposes both basic solutions into a set of elementary components. Then, one composes the novel solution by combining the elementary components from the two basic solutions. Again, many examples could be found in the quoted references, when combining control flow and data flow architectures or when combining two different software paradigms.

2.3. Transdisciplinarization

One can transport ideas or solutions from one field to another. If the transport of ideas happens without any essential changes, the approach is referred to as modification-based. If, at the same time, proper changes are introduced, the approach is referred to as mutation based. Basically, inspiration for creativity in one field could come from any other field, and the novel solution could depart less or more from the unsprung solution. There are many examples, from speech analysis to electroacoustics in which the same theory with a different interpretation of the related parameters in seismics or circuits has created the bases for success in voice recognition tools and music hall design.

2.4. Remodeling

In this approach, there exist two related sub-approaches: Granularization and Reparametrization. In the first case, a new model of a process is developed, with a lot more details, and in such a model one can possibly see a number of novel avenues that could lead to an invention, which is better than the best solution from the open literature. In the second case, one can insert into the existing model different values for the parameters that already do exist in the existing model. However, with the new values of parameters, optimal solutions become different, and may require a different design or solution, and this new design or solution could represent an innovative novel solution. Examples of the first case could be found in the work of several Nobel Laureates, while the examples of the second case are abundant in situations when existing paradigms have to be reimplemented in a new technology, or old programs have to be ported into a new programming model. Examples could be found in GaAs computers or in GaAs systolic arrays.

2.5. Unorthodoxization

If one stands at a higher level, one sees more. If one starts digging into details with full respect for each and every detail, one can see what those before could not. In the view from above, we get a large picture; in the view from inside, we see details that could be of crucial importance for a new creation. These two methods are of special interest for problems that require new solutions to be found using creative thinking on higher levels of abstraction. Examples could be found in methods to improve software scalability or software reliability.

3. Conclusion

The presented approaches have been used in a number of research efforts that the author has studied. Work of 19 Nobel Laureates has been analyzed and classified according to the classification presented in this article. Also, the work of the researchers listed on the top 500 list for computer science, based on the h-index. The follow up study of the author will analyze potentials of the presented approaches in social studies and the humanities. The bottom line is that the more creative the educational process in a nation, the brighter is the future of the nation.

Acknowledgements

Creative thinking of the author was inspired by works of the following 19 Nobel Laureates, whose work he studied in the context of creativity and methods to induce or enhance creativity: Zhores Alferov, Kenneth Arrow, Leon Cooper, Piere-Gilles de Gennes, Jerome Friedman, Sheldon Glashow, Stefan Hell, Tim Hunt, Daniel Kahneman, Harold Kroto, Jean-Marie Lehn, Eric Maskin, Konstantin Novoselov, Arno Penzias, Robert Richardson, Dan Shechtman, Herbert Simon, Kenneth Wilson, and Kurt Wuethrich.

Literature

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