

ADDRESSING THE DIMENSIONS OF EDUCATION AND INTEGRATED CURRICULUM VIA GENERALIZED FUZZY LOGIC

TUDOR MARIN,*

marintud@yahoo.co.uk

GHEORGHE SĂVOIU**

gsavoiu@yahoo.com

Abstract: *In terms of the criteria used, and also comprehensively, a classification of education, considered already classical in the light of its fundamental dimensions, is slightly ambiguous, even if it easy to state; education issues today demonstrate that the structural make-up of education as formal, non-formal and informal presents many aspects of interference, overlapping and transfer, inevitably leading to vague areas. Addressing the dimensions of education and integrated curriculum by applying the generalized fuzzy logic professed by the young Romanian Florentin Smarandache deciphers the intricacies and seems to solve the doubts.*

Keywords: *fuzzy logic, generalized fuzzy logic, formal education, non-formal education, informal education.*

Introduction

In an article entitled *Why mathematics in Social Sciences*, John Galtung identifies four ways to invoke mathematics: a) out of snobbery; b) because, like many drugs, it does not harm; c) because it is useful; d) because it is inevitable. We believe that *the same methods can be extended to the application of logic or statistics to the social domain*. If the methods under a) and b) present major doubtful signals as far as the constructive interference of mathematics in the social sciences, unprofessional application of logic, statistics and mathematics, or even the incorrect capitalization of various

* Lecturer PhD., "Dimitrie Cantemir" Christian University, Bucharest, Romania.

** Associate Researcher PhD., National Institute for Economic Research „Costin C. Kirițescu”, Center for Mountain Economy CE-MONT, Romanian Academy, Bucharest, Romania.

methodologies generate subsequent refusal of social application of a number of methods already established in other fields...

The present mini-study attempts to clarify (or rather codify?) a classification of education, considered already established, yet slightly ambiguous even if easy to state, i.e. a structural arrangement in terms of formal education, non-formal and informal learning, by applying Florentin Smarandache's generalized fuzzy logic.

Failure of total formalization by applying special types of mathematical logic and specific statistical-mathematical methods, starts from a correct premise and, above all, does not slip into a false conclusion typical of today's world, i.e. completely challenging statistical and mathematical logic in the humanities.¹

1. Generalized fuzzy logic

Before making an application of a new type of logic, it ought to be grounded and presented from a theoretical angle, as a process of thinking or understanding with implicit deductive connotations. In fuzzy logic and its specific approximative reasoning, the rule of the inference process is of the generalized *modus ponens* type. The issue of fuzzy logic was generalized by Romanian mathematician and logician Florentin Smarandache². Generalized fuzzy theory, or *neutrosophy*, studies and reconsiders the origin, nature, and purpose of neutralities, as well as the specific interactions. Smarandache's fundamental thesis³ is based on the fact that any idea $\langle A \rangle$ is $T\%$ true, $I\%$ indeterminate and $F\%$ false, where T , I , F are standard or non-standard subsets, included within the non-standard interval $]0, 1+[$. Thus, according to neutrosophy, every $\langle A \rangle$ idea tends to be neutralized, diminished, balanced by $\langle \text{Non-}A \rangle$ ideas (not only by $\langle \text{Anti-}A \rangle$ ideas, as a steady state).

Each concept or definition, A for this article, together with its opposition or negation, Anti-A, and the spectrum of neutralities, Neut-A (for instance, the concepts or definitions lying between the two extremes and support neither the A idea, nor the Anti-A idea). The Neut-A and Anti-A ideas considered together are called Non-A. Each definition A tends to be neutralized and balanced by Anti-A

¹ Marcus, Solomon, *Mathematics` Cultural Chance*, in "The Challenge of Science", Political Publishing House, Bucharest, 1988, pp 451-457.

² Smarandache, F., A Unifying Field in Logics: neutrosophic logic, *Multiple Valued Logic / An International Journal*, vol. 8(3), 2002, pp. 385-438.

³ Smarandache, F., Neutrosophy, A New Branch of Philosophy. *Multiple-Valued Logic / An International Journal*, Vol. 8, No. 3, 2002, pp. 297-384.

and Non-A definitions to maintain the balance. Finally, neutrosophy is the grounding of neutrosophic logic or generalized fuzzy logic, which focuses on the main idea to characterize each logical sentence in a neutrosophic three-dimensional space, the dimensions of which represent the truth (A), false value (F) and indeterminacy (I) of the sentence considered, and where A, F and I are real standard or non-standard subsets of the non-standard interval]0, 1+[.

In so far as the structural definition of education is concerned, the inference would be of the max-min type. Also, the variant of formal education is defined as a maximum interest area (so it is assigned a value of 1, which is specific to the binary or dichotomous variable), which causes non-formal education to automatically acquire the value 0, in the spirit of the same two opposing values, 1 and 0. A value of 0 is also a reflection of the lack of coercion in the educational process, as the dominant factors are passion, and absence of evaluating at any price – and consequently a number of conditions of teaching opportunity are confirmed, such as: the principle of learning by doing, presented by J. Dewey, the motivational optimum principle (D. Baerlyne), the effect principle (E.L. Thorndike) and the principle of effort and time economy (E. Claparède), etc. The leap from the formal to the non-formal type is a subtle shift from the rigors of the laws to the flexibility of the principles in education...

In summary, the more education, defined deductively and based on the (non-generalized) logic of fuzzy inference, tends to become less coercive, the more its non-formal area is expanded, i.e. the compulsory, universalized character of training and standardization of cumulative-summative assessment decreases (as a percentage of the whole educational process). By concentrating the ideas above, the more generalization of compulsory school and chronological, stage-oriented graduation is minimized, as well as standardized assessment, the more education is diversified, therefore the role of coercion and punishment becomes, or tends to 0, being replaced by pleasure and even passion in learning.

In a slightly different approach, the obligation appears to make a connection with all educational spaces outside the standard range [0, 1], concretely belonging to the non-standard interval]0, 1+[, which also facilitates, and conduces to, an informal/incidental education, which spans the entire period of human life...

According to this final generalized logic, the definition of the areas of the dimensions of education shifts from the classical type of education, coercive and characterized by maximum coverage, within the spectrum of

universalized and standardized assessment, towards the non-formal type of education, which, through passion and attraction, can no longer be superimposed, along the axis of assessment truth, to a false type of education, completing it, to the maximal degree, with a formal, incidental type of education. The relatively standardized classification of education as formal, non-formal and informal reveals a rather awkward understanding, and even a certain ambiguity of criteria, but this can be improved by resorting to generalized fuzzy logic.

Several structuring criteria can be presented, by capitalizing on the same logic:

A. Criteria expressed synthetically

The binding nature of assessment YES = 1 and NO = 0

The degree of full coverage and universalization YES = 1 and NO = 0

Validity and standardization of assessment YES = 1 and NO = 0

Teachers YES = 1 and NO = 0

Maximal generalization of the binding nature and assessment YES = 1 and NO = 0

Formal education YES=1 *Non-formal education* NO = 0

[0; 1]

Informal education does not have a referential in [0; 1], but in]-0, 1+[.

B. Slightly detailed criteria, or criteria with some specific emphasis

Criterion 1

Education trains specialists through expert trainers specializing in education

Then YES = 1 and NO = 0

Formal education NO = 0

Non-formal education YES = 1

[0; 1]

Informal education does not have a referential in [0; 1], but in]-0, 1+[.

Criterion 2

Presence of coercion and iys application

Then YES = 1 and NO = 0

Formal education YES = 1

Non-formal education NO = 0 (centres on passion)

[0; 1]

Informal education does not have a referential in [0; 1], but in]-0, 1+[.

Criterion 3

Standardization and inflexibility of the curriculum

Then YES = 1 and NO = 0

Formal education YES = 1

Non-formal education NO = 0 (it centres on the flexibility of the curriculum)

[0; 1]

Informal education does not have a referential in [0; 1], but in]-0, 1+[, being centred on the absence of the curriculum, or the presence of extremely flexible and malleable parts of the curriculum.

2. Addressing fuzzy logic in terms of curricular transfer and interference of the dimensions / forms of education

To understand the aspects of fuzzy logic in education one needs to produce clarifications regarding the interference of the dimensions / forms of education and the level of curriculum integration.

2.1. The three dimensions / forms of education (formal, non-formal, informal), seen from the angle adopted by Coombs, Prosser, Ahmed (1973),⁴ have the following definitions:

- *formal education* – a system of education having a hierarchical structure and chronological stages, starting from primary school to graduating university, including, in addition to general academic studies, various specialized training programs.

- *non-formal education* – any educational activity organized outside the existing formal system, which is designed to meet the educational needs of a particular group, and pursues clear learning objectives.

- *informal education* – a real life-long learning process, in which each individual forms his/her own attitudes, internalizes or clarifies certain values, acquires skills and knowledge from everyday experience, drawing on the influences and educational resources of the the environment or milieu where he/she lives.

In Romania, the dimensions / forms of education have been studied by many educationalists and teachers,⁵ who have revealed the complexity

⁴ Coombs P.H., Prosser C, Ahmed M., *New Paths to Learning for Rural Children and Youth*; International Council for Educational Development, New York, 1973.

⁵ Cergit I, G. Văideanu, 1988, in „Pedagogics Course”, University of Bucharest; S. Cristea, 1998, in „Pedagogics Dictionary”, EDP, Bucharest; M. Călin, 1996, in „*The Theory of Education. Epistemic and Methodological Fundamentals of Education*”, All Publishing House, Bucharest C. Cucoş, 1996, in „*Pedagogics*”, Polirom Publishing House, Iaşi; T. Cosma, 1988, in „*School and Facultative Education*”, Al. Ioan Cuza University Publishing House, Iaşi Venera-Mihaela Cojocariu, 2008, in “*The Fundamentals of Pedagogics. Theory and Methodology of the Curricula. Texts and Motivations*, V&I Integral Publishing House,

of the paideutic act, and, within this context, they have emphasised the fact that the training and actual shaping of human personality “includes all kinds of influences that are, or may be considered formative.”

It should be pointed out that a clear distinction between the three forms of education appears when referring to the area where the type of education in question occurs. The three “parallel forms” of education are not parallel in the geometric sense, since they are converging due to the impact of the principle of lifelong learning. In this context, there occur elements of both transfer and interference or overlapping, vague areas, as shown by the fuzzy logic approach, which we briefly present in the following allegations:

- there are no rigid boundaries between the forms / dimensions of education, but rather “penetration and interaction”, and so overlapping and interference;

- the forms / dimensions of education can occur / act simultaneously or successively, sometimes in agreement with each other, and sometimes in a contradictory manner (Th. a Belle), and so formal education is not always in the centre;

- the increasing formative impact of socio-cultural institutions and, especially, of the natural and social environment, leads to overlapping, and reduce the force of integration of formal education;

- the sheer scale of non-formal education impacts the quality and integration of the formal and the informal, often leading to the appearance of the process of vulgarization of science, art and culture; non-formal education is not articulated with institutional education, and therefore overlaps formal education; the relationship between non-formal education and formal education should be one of complementarity, both in terms of content and in terms of methods and final achievements⁶;

- the informal messages emitted by the media manipulate, and can even produce “brainwashing” when the power that formal education has to mitigate the negative influences decreases;

- the emergence of the new types of education (peace education, environmental education, education for participation and democracy,

Bucharest T. Marin, 2012, în „*Fundamentals of Pedagogics. Theory and Methodology of the Curricula, Contemporary Education Issues*, V&I Pro Universitaria Publishing House, Bucharest.

⁶ T. Cosma, “*School and Facultative Education*”, Al. Ioan Cuza University Publishing House, Iași, 1988.

demography education, education for change and development, education for communication and media, nutrition education, economic education, leisure education, community education, education for the fundamental human rights, etc.) often leads to overlapping and interference between the formal and non-formal.

Beyond the weaknesses that occur due to the various interferences, we must see the strengths, the favorable points, substantiated by transfer, which appear when the three forms / dimensions of education are integrated. Here are some examples:

- it provides extensions and beneficial transfers / interpenetration with respect to making the educational approach more efficient, because the three forms are interdependent;
- it develops the capacity to respond to complex situations and needs;
- it ensures awareness of specific, entirely new situations;
- it provides superior awareness of individual and collective needs.

2.2. Curriculum integration, which is feasible through the following stages: disciplinarity / mono-disciplinarity, multidisciplinarity / pluridisciplinarity, interdisciplinarity, transdisciplinarity, has become a necessity, because contemporary world problems require rapid responses from education.

Ciolan (2008) stated the goals of curricular integration, namely bridging the gaps or breaks between disciplines, which generate “white spots”, the synergy of the fields of the various educational disciplines (both in the scientific research, and in the curriculum), building, via education, a set of dynamic mental structures, solving problems.⁷ These finalities of integration generate both transfer and elements of interference, so a brief overview of the characteristics of integration steps is in order.

Mono-disciplinarity emphasizes the predominant role of each discipline seen as a whole. From this perspective, the study subjects are seen separately, each with its independence, which leads to “white spots” or vague areas in the overall educational curriculum and system. Nevertheless, there are also elements of intra-disciplinary transfer (i.e. within the same discipline). For example, the chapters / training units within a learning subject or discipline.

⁷ Ciolan L., *Integrated Learning. Fundamentals to a Transdisciplinary Curricula*; Polirom Publishing House, Iași, 2008.

Multidisciplinary / pluridisciplinarity is a form of interdisciplinarity which consists in a simple correlation of elements belonging to several disciplines, which are put to work together. For example, the topic of electrolysis, treated in terms of complementary integration (physics, chemistry, technology); the topic / theme of acid rain and water, seen in terms of parallel integration (chemistry, geography, ecology, etc.)...

Interdisciplinarity, whether centripetal or centrifugal, requires cooperation by intersection and interaction between related disciplines in dealing with a common theme, that is to say the “white spots” or overlapping spots can be treated...

Transdisciplinarity, as the highest form of curricular integration, can lead to the emergence of new border disciplines, but the subject is too vast to be dealt with as part of the present study.

A final remark

The contribution of the Romanian mathematician and logician Florentin Smarandache and his neutrosophic logic, or generalized fuzzy logic, redefine the matters in a simpler, clearer and more comprehensible manner, suggesting probabilistic scenarios or having recourse to neutrosophic probability. The function that models the neutrosophic probability of a specific activity or characteristic science of education consequently becomes a random variable and finally generates a neutrosophic distribution: $PN(x) = [A(x), F(x), I(x)]$, where $A(x)$ represents the probability that education or educational science x can appear as *formal*, $F(x)$ is the probability that education and educational science x is not formal, i.e. is *non-formal*, and $I(x)$ is the probability (definite or not) of education or a science of education x to be *informal*. The concrete resumption of the above reasoning by any of the criteria discussed in the article, from the *binding nature of the assessment*, to the *full extent of coverage and universalization*, from *evaluation validity and standardization* to the *presence of coercion and its application*, or the *standardization and inflexibility of the curriculum*, confirms the complexity and relevance of taxonomic approaches by neutrosophic logic, or fuzzy generalized logic.

REFERENCES

Biehler, R., (1994), *Probabilistic Thinking, Statistical Reasoning, and the Search for Causes – Do We Need a Probabilistic Revolution after We Have Taught Data Analysis?*, Research Papers from the Fourth International

Conference on Teaching Statistics, Marrakech 1994, The International Study Group for Research on Learning Probability and Statistics, University of Minnesota.

Borovcnik, M., Peard R., (1996), *Probability*, A. Bishop (eds.), International Handbook of Mathematics Education, part I, Kluwer Academic Publishers, Dordrecht.

Călin, M., (1996), „*The Theory of Education. Epistemic and Methodological Fundamentals of Education*”, All Publishing House, Bucharest.

Cergit, I, G. Văideanu, (1988), „Pedagogics Course”, University of Bucharest; S. Cristea, 1998, in „Pedagogics Dictionary”, EDP, Bucharest;

Ciolan, L., (2008), *Integrated Learning. Fundamentals to a Transdisciplinary Curricula*; Iași, Polirom Publishing House.

Cojocariu, V.M., (2008), „*The Fundamentals of Pedagogics. Theory and Methodology of the Curricula. Texts and Motivations*, Bucharest, V&I Integral Publishing House.

Coombs, P.H., Prosser C., Ahmed M., (1973), *New Paths to Learning for Rural Children and Youth*; International Council for Educational Development, New York.

Cosma, T., (1988), *School and Facultative Education*, Al. Ioan Cuza University Publishing House, Iași.

Cucoș, C., (1996), „*Pedagogics*”, Polirom Publishing House, Iasi.

Galtung, Johan, (1980), *Why mathematics in Social Sciences*, Oslo - Bergen - Tromso, pp. 206-212. Hoerl, R.W., Snee, R.D., (2002), *Statistical Thinking: Improving Statistical Performance*, Pacific Grove, CA. Duxbury Press / Thomson Learning.

Marcus, Solomon, (1982), *Algorithmic Thinking*, Bucharest, Technical Publishing House.

Marcus, Solomon, (1987), *Habits of Mind*, Bucharest. Scientific and Encyclopaedic Publishing House,

Marcus, Solomon, (1988), *Mathematics` Cultural Chance*, in “The Challenge of Science”, Political Publishing House, Bucharest.

Marin, T., (2012), „*Fundamentals of Pedagogics. Theory and Methodology of the Curricula, Contemporary Education Issues*, Bucharest, V&I ProUniversitaria Publishing House.

Moineagu, C., Negură I, Urseanu V., (1976), *Statistics*, Bucharest, Scientific and Encyclopaedic Publishing House.

Săvoiu., G., (2003), *General Statistics. Arguments for Building up Statistical Thinking Skills*, Pitești, Economic Independence Publishing House.

Smarandache, F., (2002), *Neutrosophy, A New Branch of Philosophy. Multiple-Valued Logic / An International Journal*, Vol. 8, No. 3.

Smarandache, F., (2002), A Unifying Field in Logics: neutrosophic logic, *Multiple Valued Logic / An International Journal*, vol. 8(3).