THE CONTEST IN SCIENCE CREATIVITY „ŞTEFAN PROCOPIU" - A CONTRIBUTION TO THE MULTIPLE INTELLIGENCES THEORY UNDERSTANDING AND APPLICATION IN SCHOOL

IULIAN LEAHU, Physics Teacher, Iasi, Romania

"Ştefan Procopiu" Contest is a pedagogical assessment activity dedicated to the middle and high schools students (ages: 13-19). It was initiated between 1995-1997 in Iasi (Romania), and ever since it has been organized annually, at local, department and national levels. The Contest aims to stimulate creative learning in physics and the related technologies and to promote, under the creativity factors, new school performance categories. In this respect, the Contest follows some distinctive objectives: to highlight the transfer and creativity objectives of the school subjects; to extend the game of the assessed learning products in a broad range of science skills; to create educational assessment situations which are suitable to the students intellectual profiles. The traditional pedagogical assessment of science skills is "product centered" (involving a large amount of criteria difficult to use as a whole), applied in a relative narrow skills range (scientific thinking or practical skills) and mostly "coded" in a logical-mathematical and linguistic manner. By contrast, the "Ştefan Procopiu" contest is focused, respectively, on specific "science creative profiles", a broad science skills range (theoretical, experimental and technical thinking, anticipative imagination, creative thinking factors etc.), communication in a variety of "symbolical codes" suitable to the students' intellectual profiles, based on H. Gardner's multiple intelligences theory.

The pedagogical assessment proposed by the "Ştefan Procopiu" Contest is realized on two basic psychological dimensions: a *skills - attitudes* one which represents the student's creative potential; an *intellectual* one, which is viewed as the *interface* between the potential creativity and the manifested creativity. When acting creatively or learning a subject, the students attain the maximum of performances if they are helped to harmonize this two dimensions, to meet an "intelligences combination which ensures the most efficient execution of a task" (Gardner, H., 2006). Thus:

- the CREATIVE PROFILES that are assessed are represented by the Contest *Diplomas (skills awards)*, namely: 1. "Archimedes" (perspicacity), 2. "Copernicus" (flexibility), 3. "Galileo" (experimental skills), 4. "Newton" (theoretical skills), 5. "Edison" (productivity), 6. "Coandă" (technical skills), 7. "Jules Verne" (anticipative imagination), 8. "Einstein" (originality), 9. "Procopiu" (a broad science skills range);
- the students INTELLECTUAL PROFILES are represented by the Contest *Sections*: I. "Test Papers", II. "Lab activities", III. "Work Groups", IV. "Mechatronics", V. "Scientific presentations", VI. "Applied (technological) physics", VII. "Physics & Computer", VIII. "Physics & Arts".

The role of the Contest *Sections* is to ensure, from the multiple intelligences perspective, multiple assessment situations favoring the students' creative manifestations. In this respect, beginning with 1997-1998, the "Ştefan Procopiu" Contest has been developed on the basis of certain methodological premises:

1. *the creative potential* of a student can be described as the interaction of three groups of psycho-behavioral factors: disciplinary skills, creative thinking skills, intrinsic motivation (J.S. Renzulli, 1978 and T.M. Amabile, 1983);
2. the creative potential manifestations of a student depend on the existence of a set of favorable conditions (educational situations) which school is asked to offer. If we understand the intelligence as the student's capacity to efficiently use the educational conditions for her/ his proper development, then the proper educational situations should reflect the *construction of* her/ his *intellect* or *intellectual profile*;
3. a student is able to manifest creatively, when she/ he is encouraged to discover the "intersection" between her/ his *creative potential* and *intellectual profile*;
4. to define the students various intellectual profiles - on the basis of which we create the favorable educational situations - H. Gardner's *multiple intelligences theory* offers the essential frame.

According to the psychological models of J.S. Renzulli (1978) and T.M. Amabile (1983), the creative potential is the result of the "intersection" of three groups of psycho-behavioral factors: 1. disciplinary skills; 2. creative thinking skills; 3. intrinsic motivation. These groups of factors interact in a specific way when a student is engaged in a creative activity in a certain domain (school subject) and represent the inborn availability of every student, but in permanent development by creative learning, depending on the cultural and social (cooperative) environments in which everyone learns.

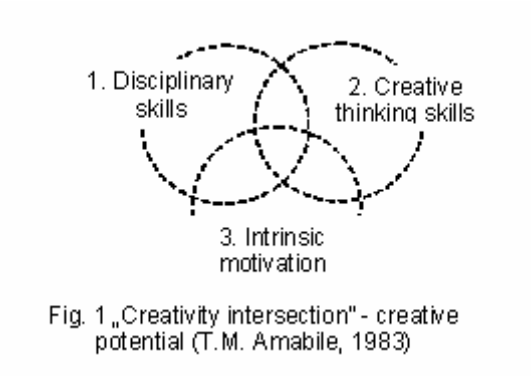


Fig. 1 „Creativity intersection" - creative potential (T.M. Amabile, 1983)

]By the combination of these "skills-attitudes" characteristics it results a (reasonable) number of creative profiles defining a variety of school performances categories specific to the learning of physics and the related technologies. Similarly, they can be defined creative profiles for each school subject, as school performance indicators and, consequently, a new vision on the "school learning efficiency": *creative learning efficiency*. Pedagogically, the ensemble of creative profiles specific to a school subject constitutes the *interface* between the psychology of creativity and the dedicated didactics.

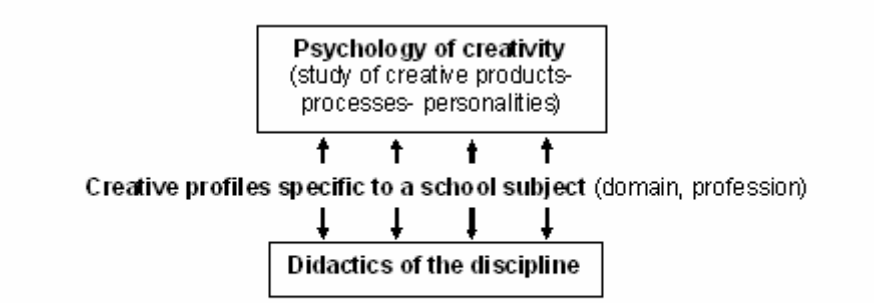


Fig. 2 – Creative profiles specific to a school subject constitutes the interface between the psychology of creativity and the dedicated didactics

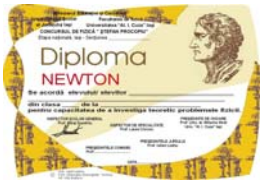
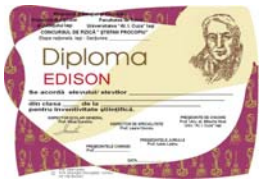
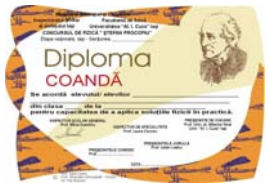
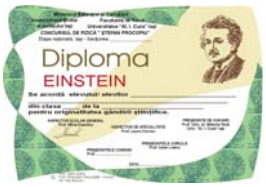
An "skills-attitudes" inventory which generates the creative profiles specific to the study of physics and the related technologies is presented in the next table:

Table 1

Groups of factors	Components
1. Disciplinary skills	• Theoretical; • experimental; • technological; • anticipative imagination.
2. Creative thinking skills	• Sensitivity to problems; • fluidity (verbal, associative, expressive); • flexibility (spontaneous, adaptive etc.); • originality of thinking; • elaborative capacity.
3. Intrinsic motivation (task involvement)	Attitudes and personality features conditioning the efficiency (easiness, rapidity) of the thinking processes: • high interest levels; • fascination and involvement in particularly problems; • enthusiasm; • disposal to use techniques which stimulate creative thinking; • attention focusing and mobility; • perseverance, devotion, high standards for the own results; • self-esteem; • humor; • tolerance to ambiguity; • responsiveness to critics etc.

The varied combinations of these three groups of factors - which we observe in the students' scientific behaviors - guide us to construct the tests for the Contest's Sections: I. "Test Papers", II. "Lab activities", III. "Work Groups", IV. "Mechatronics" and to define the assessment criteria of the projects presented by the students at the next Sections: V. "Scientific presentations", VI. "Applied (technological) physics", VII. "Physics & computer", VIII. "Physics & Arts". The students' creative (science skills-attitudes) profiles, specific to the study of physics and the related technologies, will present individual arrangements of these three categories of variables described in the next table.

Table 2. *Creative profiles* specific to the study of physics and the related technologies

	**Archimedes (Perspicacity)** Sensitivity to problems, perceptive sensitivity, associative fluidity, spontaneous flexibility.		**Copernicus (Flexible science thinking)** Speculative thinking, sensitivity to problems, flexibility (spontaneous, adaptive), elaboration.
	**Newton (Theoretical investigation)** Sensitivity to problems, theoretical thinking, ideational fluidity, adaptive flexibility, elaboration.		**Galileo (Experimental investigation)** Experimental skills, perceptive sensitivity, sensitivity to problems, associative fluidity, adaptive flexibility, elaboration.
	**Edison (Inventiveness, scientific productivity)** Sensitivity to problems, fluidity (ideational, associative, expressional), flexibility, elaboration.		**Coandă (Technical aptitudes, relating solutions to facts/ reality)** Sensitivity to problems, perceptive sensitivity, plausibility, technical thinking, flexibility, elaboration.
	**Jules Verne (Anticipative scientific imagination)** Sensitivity to problems, fantasy, fluidity (ideational, associative, expressional), flexibility, elaboration.		**Einstein (Originality of scientific thinking)** Sensitivity to problems, non-conformism, associative fluidity, flexibility, humor.
	**Procopiu (gifted for the physics and the related technologies study)** Cumulates the previous profiles, in a broader skills range and at a higher rhythm of the cognitive development.		

In order to stimulate the creative potential of a student we need to identify the conditions (educational situations, learning environments, media) in which it can be produced: What intellectual abilities do students frequently use in their learning environments? What intellectual combinations enables them to efficiently complete a learning task? What educational means activate their intellectual abilities which seem to be invisible? In what "terms" must we create the educational situations favorable to a student? Terms like "learning situations", "means", "ways", "media", "environments" etc. suggest the "intellectual interface" which the school is asked to create between what a student "is" in a fortuitous/ random educational environment and what the student "can be" in deliberate favorable conditions. Thus, we understand the **intellectual profile** of a student (in respect to a school subject) as a variable disposed at the interface between her/ his creative potential and creativity manifestations. Pedagogically, this variable corresponds to the learning situations which presents a certain configuration of the conditions favorable to the creative manifestations.

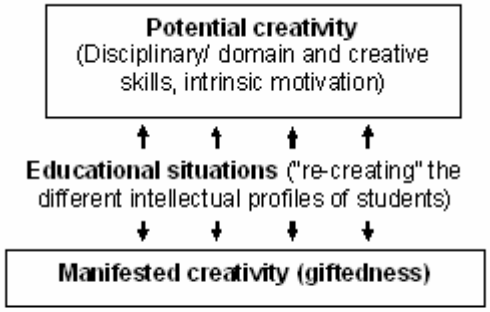


Fig. 3 The educational situations which favor the students' creativity manifestations "re-create" their different intellectual profiles

In order to stimulate the students' development at their maximum potential, the school should create learning-evaluation situations corresponding to their intellectual profiles. Paraphrasing R.M. Gagné, "every *creative profile* starts from another configuration of internal capacities (*creative potentials*) and asks another external situation to realize it (corresponding to the *intellectual profile*)". To attain this purpose, the multiple intelligences theory offers the essential frame. H. Gardner (1983) identifies a set of intelligences (*logical-mathematical, verbal-linguistic, spatial-visual, naturalist, bodily-kinesthetic, musical, intrapersonal, interpersonal*) which are grouped in intellectual profiles that are unique for every student. Paraphrasing T.M. Amabile, the fundamental challenge for a teacher to support the creative performances of his students consists in helping everyone to discover the "intersection" between her/ his own *creative potential* and *intellectual profile*, the "place" where the creativity is most likely to manifest. The next table presents the intellectual profiles related to a variety of assessment situations that are proposed by the Contest Sections:

Table 3

	**Section I.** **Test Papers** *Examination:* creative problem solving, written, individual tests proposed by the teachers. *Intellectual profile*: logic-mathematical, verbal-linguistic.		**Section V.** **Scientific presentation** *Examination*: written studies on themes proposed by students, public exam. *Intellectual profile*: logic-mathematical, verbal-linguistic.
	**Section II.** **Lab activities** *Examination*: lab works, written-practical tests proposed by the teachers, 2-3 students team. *Intellectual profile*: logical-mathematic, spatial-visual, corporal-kinesthetic.		**Section VI.** **Applied physics** *Examination*: practical works on themes proposed by students, public exam. *Intellectual profile*: naturalist, spatial-visual, bodily-kinesthetic.
	**Section III.** **Work groups** *Examination*: group projects, written-practical tests proposed by the teachers, 3-5 students team. *Intellectual profile*: verbal-linguistic, logical-mathematic and interpersonal.		**Section VII.** **Physics and computer** *Examination*: educational soft on themes proposed by students, public exam. *Intellectual profile*: logic-mathematical, spatial-visual.
	**Section IV.** **Mechatronics** *Examination*: technological works, written-practical tests proposed by the teachers, 2-3 students team. *Intellectual profile*: logic-mathematical, spatial-visual, bodily-kinesthetic.		**Section VIII.** **Physics and arts** *Examination*: literature, painting, theatre, movie etc. on themes proposed by students, public exam. *Intellectual profile*: verbal-linguistic, spatial-visual, intrapersonal, bodily-kinesthetic, existential.

According to H. Gardner (1993, 2006), the students are different mostly because they all have different intelligence combinations. The *intellectual profile* offers a snapshot of student's intelligence, generally unregulated, with strengths and weaknesses, as a result of the genetic inheritance, different access to categories of information, development under the influence of educational experiences etc. Inside a profile, the intelligences interact differently: they can limit or obstruct one another, compensate or amplify, increasing or decreasing the overall intellectual potential. In a cognitive activity, the weaknesses and strengths of an intellectual profile may be of the same importance. To increase the creative learning efficiency, "not the total amount of intelligence is important, but the manner in which different levels of intelligences interact in solving a problem" (Gardner, H., 2006). The school must identify and stimulate the different intelligences and intellectual profiles of the students, so that everyone confronts properly with the school demands and the multiple life issues. If school activates the whole intelligences spectrum, the students will better understand their intellectual potential and, correspondingly, their favorable performance conditions in different domains, at a certain moment.

Intelligence is not a unique faculty settled to resolve any kind of problems, “but a repertoire of distinct capacities, responsible with the different kinds of information processing” (Gardner, H., 2006). Because “intelligences operate with representations or symbols depending on context”, to construct educational environments favorable to every students implies to stimulate them to approach “contextualized” tasks. The notion of “context” is essential to the intelligence understanding, both within the frame of multiple intelligences theory and of “Ştefan Procopiu” Contest. Multiple intelligences theory adopts terms as “contextualized intelligence” and “distributed intelligence”; “Ştefan Procopiu” Contest conceive equivalently the intelligence as the “interface” between the students’ creative potentials and their creative manifestations.

In referring to its conceptual evolution, since 1997-1998 the Contest has been naturally developed on two dimensions, firstly, of the *disciplinary skills*, secondary, of the i*ntellectual abilities* - represented, respectively, by the Contest *Diplomas* and the Contest *Sections* - by contrast to the *multiple intelligences theory*, in a reversed order in respect to its educational application. First, there were outlined the creative (skills-attitudes) profiles specific to the study domains (“Archimedes”, “Copernicus” etc., reported to an unique logical-linguistic intellectual frame (the Contest Section named “Test Papers”), then, in more and more varied situations, in the light of multiple intelligences theory (“Lab activities”, “Work Groups” etc. We distinguish between “creative profile” and “intelligences profile”, similarly as H. Gardner (2006) distinguishes “between intelligences and domains”. “Domains” are the different professions and occupations which may be identified in a culture (Gardner, H., 2006), including their specific body of knowledge and skills. In his initial works, H. Gardner (1983) has illustrated the intelligences by means of the creative skills portraits of certain personalities in different domains (this is a tacitly assumption that the maximum cultural performances are attained when the skills-attitudes profile of a person agrees to her/ his intellectual profile. Later, H. Gardner (2006) notices the different nature - psychological, respectively, sociological - of “intelligences” and “domains” and the fact that “this confusion has contributed to erroneous applications of multiple intelligences theory in the educational practice”. In the traditional school, the confusion between “intelligences” and “disciplinary skills” - supported by the abusive use of intelligence tests - explains the reduction of these to “intellectual development”: “X is able to learn, if she/ he is properly intellectually developed”. As the traditional understanding of the intellect was logical-mathematical and verbal-linguistic based - by the authority of the IQ tests and the classical lessons format - these couple of intellectual abilities became the main “entry point” of any student in any discipline and the most trustworthy “route” to everyone skills development. By contrast, in accordance to the multiple intelligences theory, within the intellectual profile the student X disposes of a variety of “intelligences”, offering multiple “entry points” in any school disciplines and “multiple ways” for the personal development. Irrespective of X’s strengths or weaknesses in a domain, the teacher’s role is to support X to complete the tasks, by creating learning situations that are favorable to X’s intellectual profile.

Since its debut, in 1997-1998, the “Stefan Procopiu” Contest has been naturally developed on the distinction between “creative profile” and “intellectual profile”. The last is viewed as the interface between the creative potential in a domain and the creative manifestation. The role of the Contest Sections is to provide a variety of assessment situations which are related to the students’ intellectual profiles, in order to favor their creative manifestations. Thus, we conceive the *intellectual profile* from two perspectives that are congruent with H. Gardner’s understanding of intelligence:

- from an *individual (internal)* perspective, intelligence is a set of abilities that are grouped as unique intellectual profiles for every student, enabling them to efficiently execute tasks, adequately to the own intellectual profile: to acquire and to transmit knowledge in different symbolic codes, to use knowledge “intelligently”, as “entry points” or “development routes” in a domain (school subject) etc.;
- from an *external* perspective, that of the educational situations, “intelligent” are those situations (including teachers) which deliberately shape the students intellectual profiles (individually or in groups), supporting them to become more efficient, in a broad disciplinary skills range.

Two students - as two teachers - will not use their own intelligences or exploit the “intelligent” situations in the same way. The internal perspective on intelligence enhances “the way in which everyone completes a certain task” and “because every cultural role claims a variety of skills, it becomes important to consider individuals as a collection of intelligences, rather than having a unique faculty to solve problems” (Gardner, H., 2006). The second meaning of “intelligent situations” is congruent with H. Gardner’s “two enlarged notions of intelligence” (2006): the “contextualized intelligence” and – “closely related to, but distinct from” - the “intelligence distributed across teams and cultural tools”, which transfer the intelligent performances (and the intelligence meaning) “beyond the individual mind”. The “cultural specific tools” and the “collective intelligence of knowledge work teams” act on the creative activities as “intellectual catalysts”, changing the intellectual profiles of individuals as cultures and societies are changing. To efficiently accomplish a pedagogical role, every intelligence must be identified and stimulated in its own individual, cultural or collective context. In the absence of an intellectually proper environment to everyone, the education appears as a “de-contextualized” process (Gardner, H., 2006): discontinuous in what it and the society transmit and appreciate as authentic values; based on abstract learning contents situated “beyond of what we consider the limits of authentic human knowledge”; focused on the quantification of individual knowledge, “which can seriously distort the competencies of a student and her/ his possible contributions in a larger and more

adequate social frame"; preponderantly based on logical-mathematical or verbal-linguistic symbolical codes, irrespective of the different learning competences aimed and the students' real potential. Therefore, the students' creative (skills) potential in the different school subjects remains invisible or disappear.

In conclusion, in order to elaborate the concept of creativity assessment promoted by the "Stefan Procopiu" Contest, we needed to distinguish two axes: (1) an *epistemological* one, the axis of the principal creative (skills) profiles specific to the involved school subjects; (2) an *psychological* one, the axis of the assessment situations corresponding to the students' intellectual profiles. In their creative learning, the students attain the maximum of their performances when they are helped to optimally connect these two dimensions. This implies a new methodology which the "Stefan Procopiu" Contest promotes in school, based on the conception of school learning efficiency at the incidence of skills profiles and intelligences profiles.

References

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