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IDENTIFICATION OF STUDENTS WITH TALENT IN THE TECHNICAL DOMAINS

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ABSTRACT. The technological evolution requires a constant innovative perspective and from this point of view innovation is the result of the creativity among the working and extremely gifted persons. There are the inventor engineers who actually have turned their potential technical talent into fact. in this paper we wish to synthesize generally the problem of the identification of gifted and talented people, and to point this with data from the studies concerning directly the identification of the persons with technical talent. Theoretical information will support the development and validation of an instrument able to identify the technical talent among the students. That is the auto-nomination inventory of talent in the technical area, the evaluation and validation process of which we'll submit in this study.

Key words: *giftedness, talent, technical talent, identification methods, identification tools, inventory*

ZUSAMMENFASSUNG. Die Identifizierung von Studenten mit Talent im technischen Bereich. Die technologische Entwicklung erfordert eine ständige innovative Perspektive. Aus dieser Sicht ist die Innovation das Ergebnis der Kreativität bei den arbeitenden und sehr begabten Personen. Die Erfinder-Ingenieure sind die, die tatsächlich ihr potentielles technisches Talent zur Realität entwickelt haben. Wir möchten durch dieses Werk das Problem der Identifizierung von begabten und talentierten Personen synthetisieren, und dies mit Daten aus den Studien deuten, die unmittelbar die Identifizierung der Personen mit technischer Begabung zeigen. Die theoretischen Informationen unterstützen die Entwicklung und Validierung eines Instruments, welches in der Lage ist, die technischen Begabungen von Studenten zu identifizieren. Das ist das Autonominierungsinventar der Talente im technischen Bereich, das Prozess der Evaluierung und Validierung, von dessen wir in dieser Studie vorlegen werden.

Stichwörter: *Hochbegabung, Talent, technische Begabung, Identifikations-Methoden, Werkzeugen für Identifizierung, Inventar*

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1. Identification of the Technically Talented Persons

Inquiries made in understanding and defining the technical talent, as a specific form of giftedness and talent, led us to the identifying of two categories: some came from the field of the psycho-pedagogical excellence research (J., Feldhusen, 2005, F., Gagne, 2009, C., Creţu, 2009, J.S., Renzulli, 2005, K., Heller, 2005) and the other from the engineers' area, who were interested in the subject of the giftedness because they wanted to understand the mechanisms generating the invention (V., Belous, B., Plahteanu, 2007, Moraru, 1980).

In this paper we consider the technical talent as the expression of the superior endowment in different areas of technical field, as the excellence, demonstrated by an outstanding performance in this field or as a potential of excellence demonstrated by the results in various forms of evaluation.

Mayer synthesizes the favorite position of the experts about the ways of identifying the gifted and talented persons and indicates two directions: on the one hand there are the researchers who support the identification of the high gifted persons rather appealing to the abilities or achievement tests, on the other there are the supporters of the identifying them rather by appealing to the evaluation of the performances (Mayer, 2005).

Thus, some assessment of cognitive skill tests are often used in the research: Terman, 1925, prefers Stanford Binet's sets of intelligence tests; Robinson, 2005, sustains measuring the cognitive skills through the traditional psychometric evaluation, that is an objective assessment of the academic results, Sternberg, 2005, uses in his research and validates the tests measuring the cognitive abilities that define intelligence of the success (creative, analytical and practical skills), joined together in the "Sternberg Triarchic Ability Test" with its different levels; Gagne, 2005, chooses for his specific programs those people that prove remarkable knowledge and talents, that places them in the first 10% among their equals. These methods of identifying the highly qualified people are criticized for assessing behaviors out of the context (Pluker, 2005) or because of their inefficiency in detecting the specific talents (R., Subotnik, L., Jarvin, 2005).

On the opposite side are the supporters of identifying gifted and talented people on the base of them performance. Jeltova, Grigorenko, 2005, prefers the identification of the performance in different academic tasks by comparing peers. The authors aimed especially the within-schools competitions, but they don't exclude other types of tasks; Heller, Perleth, Lim, 2005, militate for "searching talents" through teacher's use of the nomination guides; R., Subotnik and L., Jarvin, 2005 sustain the nominations made by the ones involved in the education of the subjects – that is, the teachers and the family members; Van Tassel-Baska, 2005 – prefers the personal portfolio or performance evaluation. These methods are criticized because of their low reliability.

More and more authors recommend the use of a battery of instruments that combine the traditional identification methods (intelligence, knowledge and/or aptitude tests, school grades, teachers' recommendations) with the non-traditional ones (nonverbal skills tests, creativity tests, portfolios, performance evaluation, parents', peers' and other community members' recommendations, interviews, questionnaires, letters of recommendation) (Leung, Conoley, Scheel, 1994, Sternberrg, 2005, Joyce van Tassel Baska, 2005).

Investigating the way to find people with technical talent, we have identified several strategies already used in practice, which we'll review here.

1.1. Nomination made by peers and teachers

F., Gagne proposed a tool in order to identify the gifted children through the nominations made by their peers or teachers. After several years of research he managed, together with his working team, to develop an instrument not to be challenged in its validity, allowing a rapid identification of the children who display a wide variety of top endowment or talent. It describes 42 skills corresponding to four areas of skills (intellectual, creative, socio-emotional, physical) and to other four areas of talent (academic, technical, artistic and interpersonal). Because we are interested in technical skills, there's the description of the psychological profiles derived from them (F., Gagne, 1995):

- Driver: skilled in working with the technical equipment, repairing simple mechanisms;
- Scheduler: very good with computers, learns by himself new programs, doesn't ask for help when a program does not work;
- Skillful: talented in inventing, designing and building all sorts of things.

1.2. Teachers' nomination by using evaluation scales or guides of evaluation

The measuring subscale of the technical talent (Del Siegle, 2004) from *the Scale for Rating the Behavioral Characteristics of Superior Students* (SRBCSS), Renzulli, 2004, is an example of a nomination scale used by the teachers, which is specifically concerned also on the technical skills of the secondary school students.

Based on the three-ring model for understanding the higher endowment, Renzulli and his teamwork developed the Scale for Rating the Behavioral Characteristics of the Superior Students, which assesses several categories of talent, including the technical one. The scale of rating the technical talent is centered on four main characteristics: expertise in using the technology, interest and initiative in using technology, assisting others in using technology, creative integration of technology. Below we describe each factor:

- Expertise in using the technology: earlier and/or faster acquisition of the technical skills than the most, easy transfer of the knowledge between different types of technologies or between different types of software programs;
- Interest and initiative in using technology: experimentation and individual learning of using different technologies, desire of expansion and satisfying his own interests in engineering;
- Mentoring in technology: assisting others in using technology;
- Creative integration of technology: creating new products (articles, presentations, etc.) by using ingeniously the technology.

1.3. Combined use of the standardized and non-standardized methods

The "STEM" concept, an acronym for science, technology, engineering and mathematics, was created in the U.S., by a group of researchers interested of the superior endowment and talent, in order to develop an optimal learning environment for inventors and scientists, which is aimed to meet the future needs in terms of the life's quality growth, economic competitiveness and national security (Subotnik and all, 2009).

In order to investigate the tendency of identifying the high school students who might fall into the category of the "STEM" talent, there has been started a national study, yielding a statistic about the frequency of using different methods of evaluation, in four categories of programs: specialized schools, apprenticeship programs, school competitions, summer classes. The specialized schools use standardized tests like SAT - Scholastic Achievement Test (Benbow, Lubinski & Sanjana, 1999, quoted by Subotnik, 2009) and school performance in 44%, together with the recommendations and the nominations of teachers, on special interest in STEM disciplines, or interviews and essays referring to the interest in STEM disciplines in 28%. The apprenticeship programs require, in their admissions programs, the demonstration of the interest in STEM fields. Adjacent to that are the high results on standardized tests (50%) and local test results (25%). The access to the national school competitions isn't restricted to any result of the standardized tests; there are some competitions that require the demonstration of interest in STEM fields, such as "Discovery Channel Young Scientists Challenge" or "Intel Science Talent Search".

The study shows the use of a wide range of methods in identifying the talented students and youth in science, engineering, or mathematics, from those requiring a high degree of standardization, to the very free ones, and that depending on the purpose and specifics of each program.

2. Auto-Nomination Inventory for Identifying the Talent in The Technical Field

The research made in the special literature has demonstrated us that the access to a standardized instrument for identifying students with technical talent may be very difficult. Those led us to the need of developing and validate such an instrument. Based on the information gave by the research concerned with the identification of the talented people we took the results of a previous study, in which we identified the prototypical psycho-behavioral elements which are specific for the technical talent (O., Anghel, 2011). So we have developed and validated the Auto-nomination inventory for identifying the talent in the technical field - *"Inventarul de Autonominalizare a Talentului în Domeniul Tehnic"* (IATDT).

2.1. Designing the instrument

In the first stage we have followed the steps below:

1. literature review;
2. conducting investigation studies about the prototypical psycho-behavioral elements, which are specific for the technical talent, by opinion polls regarding this phenomenon, directed to the experts - university professors;
3. developing the proper items of the instrument;
4. reviewing the instrument through interviews with experts (6 professors from the Technical University "Gh. Asachi" in Iasi).

IATDT is structured according to three dimensions of the technical talent (Table 1) derived during the process of documentation and investigation the teachers' view about the talent in the technical field.

Table 1: The three dimensions and their corresponding sub-dimensions

Dimensions	Expertise in using technology	Interest and initiative in using technology	Creative integration of technology
Sub -dimensions	Intuition of the ways of solving technical problems	Passion for the technical problems	Identifying the creative solutions to the technical problems
	Ability in practical implementing of the theoretical knowledge	Curiosity for discovery and continuous exploration of the technical field	Capacity in transposing the available data after the analysis and/or the synthesis of the information, in an original manner
	Easy handling of the laboratory equipment	Manifesting an open and flexible position to the innovation of the technology	Creating original objects

The first IATDT form contains 21 items. It requires a measure corresponding to a choice of subject's characteristic on a scale from 1-6, where 1 = ""it characterises me in a very little measure", and 6 = "it characterizes me strongly". Here it is the items of the instrument in phase one of our study:

1. I can intuitively find ways of solving the specific problems of the technical disciplines.
2. I have a vast bank of knowledge which facilitate me to solve the difficult practical situations.
3. I understand and learn the information offered by the teachers faster than my colleagues.
4. I know how to use more instruments, tools, equipment, software than most of my colleagues.
5. I learn quickly to handle the newly presented equipment and laboratory facilities.
6. I can quickly understand the cause and effect relationships to specific phaenomena or different mathematical models.
7. I can transform a specific phenomenon into a mathematical or informatical model.
8. I'm passionate about various issues posed by the development in technology.
9. I am excited to discover new aspects of the technique.
10. I am curious to find the roots, the sources that were at the basis of some very modern products (equipment, techniques, software, etc.).
11. I learn by myself how to use software programs which facilitate the work in my field of (technical) interest.
12. I like to experience the operation's way of a machine or a software program applied to a new situation / problem.
13. I spend extra time in order to develop my technical skills and knowledge necessary for my passion in the technical field, often in contradiction to my school study.
14. I am often absorbed in a particular subject or a technical problem.
15. I find creative solutions to some problems posed by different domains of the technical field, to which my colleagues do not usually think.
16. I rephrase a technical situation (problem, concept, etc.) in a new way after analyzing the available data.
17. I use my theoretical and practical knowledge in order to get creative products (robots, models, software, presentations of some research results, etc.).
18. I can issue a large number of ideas about a variety of technical topics.
19. I like to modify, adapt, and transform technical projects or software programs in order to enhance them.

20. I am very careful, attentive to the details when working on an interesting project for me.
21. I imagine solving some problematic situations by offering fantastic solutions.

2.2. Validation of the instrument

For the second stage we proceeded to the establishing of the validity through a factorial analysis and to the establishing of the fidelity by analyzing the internal consistency of the scale and items.
We have applied the questionnaire to 210 students of the Technical University "Gh Asachi" from Iasi in May 2011.

To analyze the factorial validity there has been applied the method of the exploratory factor research through the principal components analysis (PCA) and Varimax rotation, according to the data processing procedures in SPSS (Pall, J., 2001, pp. 151-167). Thus the 21 items of the autonomination inventory were subjected to their reduction into factors. The Kaiser-Mayer-Oklin Value, that is 912, indicates that we may confidently proceed to the factorization. This is supported also by the high value of Bartlett's Test of Sphericity, which is 3933.810.

The *Eigenvalues* evaluation of the indicators and the evaluation of the schedule resulted after the Catell's Scree test indicate a clear break after the third component and therefore it determins us to remember just these three for further investigation. The total variance of 52.224, in which the first factor contributes with 37.374%, the second with 8.494% and the third with 6.356%, indicate a good factorial validity of the built instrument.

To calculate the saturation of the items in each factor there has been proceeded to the Varimax method of rotation (Table 2). We should specify that the saturation values of below 0.50 of the items 13 and 14 forced us to eliminate these from the future investigations.

Table 2: Saturation of the each item of IATDT in the components

Items	Factors		
	Passion	Theoretical Expertise	Creativity
1		0.705	
2		0.702	
3		0.712	
4	0.555		
5	0.535		
6		0.707	
7		0.624	
8	0.754		
9	0.799		

Items	Factors		
	Passion	Theoretical Expertise	Creativity
10	0.704		
11	0.529		
12	0.698		
13			
14			
15		0.577	
16		0.514	0.572
17			0.710
18			0.587
19			0.652
20	0.610		
21			0.519

In order to check the fidelity of the scale there was chosen the method of the internal consistency analysis by calculating the index of the alpha coefficient. The 19 retained items were subjected to the statistical calculations using SPSS (Howitt, D., Cramer, D., 2006). The alpha crombach index being 0.904, it has been proved that we have a very good internal consistency and therefore a scale with a high fidelity. We also calculated the alpha crombach index for each of the three dimensions: the size of the alpha crombach index for Passion is 0.8588, for the size of the Technical Expertise is 0.8585, and for Creativity that is 0.7181.

The obtained results after validating through statistical procedures determine us to believe into a trustworthy use of the developed tool.

3. Conclusion

Students with talent in technical domains are especially important resources not only for universities but also for the reason that they will become the engines of change and economic development of our society. In these conditions there is required that the proficient students to be supported in order to become the so-called "knowledge workers".

Any supporting program for the gifted and talented people can start only if the issues related to conceptualization and identification were clarified. On the occasion of this work we wanted to point out the absence of a tool for identification of technical talent especially manifested by the youth, and to contribute with a new instrument, developed for this purpose.

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