


SPECIALIZED EDUCATIONAL CARE FOR HIGH SKILLS: a computational thinking case study

ATENDIMENTO EDUCACIONAL ESPECIALIZADO PARA ALTAS HABILIDADES: um estudo de caso de pensamento computacional

SERVICIO EDUCATIVO ESPECIALIZADO PARA ALTAS CAPACIDADES: um estudio de caso de pensamento computacional


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ABSTRACT:

High Skills or Gifted students constitute an expressive number in school classes, although they are invisible by the school community. To expand the reflections on this theme, this paper presents a case study about an adolescent diagnosed with High Abilities and who presents Computational Thinking. This is a bibliographical and qualitative research, in which the adolescent was applied to a questionnaire containing seven questions and a field for comments. The results obtained point to a sensitive data of lack of Specialized Educational Care for High Skills/ or Gifted students in school spaces. This leads us to conclude that we are losing the possibility to find, to support and to develop talents and potentials in these students.

KEYWORDS: High Abilities or Gifted; Specialized Educational Assistance; Computational Thinking.

Introduction

When the High Skills/Gifted (HS/GT) constructs are discussed, it is observed that there is a vast and heterogeneous field of characteristics. Therefore, each theorist brings his/her perspective in the definition of this concept. For this reason, this work is limited in the theoretical bases of the Three Rings of Renzulli (2014) and the Multiple Intelligences of Gardner, Chen, and Moran (2010).

According to Delou, we can define people with HS/GT as: "those who present high performance and/or potential in any domain area, isolated or combined, in creativity and involvement with the task, and such skills can appear throughout life" (Delou, 2020). The HS/GT are present in all social classes in multiple domains of intelligence - logical-Mathematic, Linguistics, Synesthetic, among many others.

Renzulli (2014) explains Giftedness through the interaction of three components: superior intellectual ability, creativity, and engagement with the task. Therefore, through this involvement and the intercession between them, the person presents characteristics of HS/GT. However, for the development of the individual with this characteristic, it is necessary to have an appropriate encouragement, as stated by Renzulli:

Gifted behavior consists of thoughts and actions resulting from an interaction between three basic groups of human traits: above-average general and specific skills, high levels of commitment to the task, and high levels of creativity (Renzulli, 2014, p. 246).

To have a gifted behavior, it is necessary to hold characteristics that interact between these three components. However, to develop this capacity, it is necessary that there is encouraging and learning environments capable of bringing out potentials that are submerged. One of the purposes for gifted education, made by Renzulli, which is relevant: "is to provide young people with the best opportunities for self-fulfillment through the development and expression of an area or a combination of performance areas in which the higher potential may be present" (Renzulli, 2014, p. 275).

The gifted behavior may be associated to one or more High Skills, such as in Computational Thinking. In this scenario, the person is compelled to use logical-mathematical intelligence to solve the questions stated because of a problem. However, when combined with creative productivity, the person seeks for methods to carry out these actions in an original form, transforming the way of doing/performing a standardized task and followed by the majority, in a singular way (Renzulli, 2014).

Nevertheless, when observing Gardner's (1995) theory on Multiple Intelligences, it is known that all human beings at birth have all intelligences: linguistic or verbal, logical-mathematical, spatial, sound, or musical, bodily kinesthetic, interpersonal, intrapersonal, naturalistic.

For Gardner:

Intelligence implies the ability to solve problems or design products that are important in a particular environment or cultural community. The ability to solve problems allows the person to address a situation in which a goal must be achieved and track the appropriate route to that goal (Gardner, 1995, p. 21).

Therefore, according to the author, every human being has an intelligence that stands out more than others. Consequently, people who present gifted behavior are those who have superior performance in some domain(s) of multiple intelligences (Renzulli,

2014). However, in Computational Thinking, it is observed the presence of two main intelligences: logical-mathematical intelligence and productive-creative intelligence since creativity is a determining factor for the creation of new products and for solving problems of the multiple orders of logical-mathematical intelligence.

We classify Computational Thinking as a method of solving complex problems that can be solved through algorithms, whose pillars are decomposition, pattern recognition, abstraction, and algorithmic thinking (Ramos, 2014 *apud* Ribeiro *et al.*, 2021). Also, according to Ribeiro *et al.* (2021), plugged or unplugged activities can be used with students to develop these skills. Such activities can be used to include students with High Skills to promote their potential, as provided for in a range of legislation that deals with care for gifted students, such as the National Education Plan (PNE) (Brazil, 2014).

According to article 8 of the PNE – valid for 10 years from its publication – the Union, states and cities must, in collaboration, ensure that students with specific needs are included and assisted in the regular public education schools. For this purpose, a goal and strategies were established in accordance with the provisions of the Special Education modality.

Special Education is defined as agreements brought up in art. 58 of Law No. 9.394/96 (Brazil, 1996), and the modality of educational care, whose individuals are people with disabilities, global developmental disorders, and HS/GT. Therefore, regarding this audience, Goal 4 of the PNE provides:

Universalize, for the population from 4 (four) to 17 (seventeen) years old with disabilities, global developmental disorders and high skills or giftedness, access to basic education and specialized educational care, preferably in the regular education schools, with the guarantee of an inclusive educational system, multifunctional resource rooms, classrooms, schools, or specialized public or private services, (Brazil, 2014).

The PNE presents nineteen strategies for Goal 4, however, in the present work, we will address strategy 4.2, which deals with:

Ensure specialized educational care in multifunctional resource rooms, classrooms, schools, or specialized services, public or affiliated, in complementary and supplementary forms, to all students with disabilities, global developmental disorders and high skills or giftedness, enrolled in the public schools of basic education, according to the need identified through evaluation, after listening to the family and the student (Brazil, 2014).

Art. 208 of the Federal Constitution (Brazil, 1988) has as its prerogative the Specialized Educational Service (AEE) to people with Specific Educational Needs (NEE) preferably in the regular education network. Since the National Policy of Special Education in the Perspective of Inclusive Education (PNEEPEI) (Brazil, 2008), until the present day, the established laws have brought the importance of equal conditions for public students of Special Education, which simplified the access and permanence of this public in all educational institutions. Although this entry into institutions represents an advance, there is still much to be done so that inclusion is a reality in schools in Brazil.

These issues highlight the non-extendable need for discussion on the forms of admission, care, evaluation processes, pedagogical organization, curricular amendments, and others, to structure the school to guarantee access, permanence, and successful completion.

From the perspective of this study, focusing on Special Education, and particularly students with HS/GT, we have verified their invisibility in our schools, even considering the advances made after PNEEPEI. We noticed that schools lack a domain on strategies for how to understand and deal with these students. Among them, we can point out some such as: training of education professionals, lack of AEE (Specialized Educational Service), lack of investments, absence of Multifunctional Resource Room, pedagogical supplementation, and more.

Therefore, we need a distinctive look of professional educators for Special Education students, an inclusive policy aimed at students with HS/GT that identifies them and leads them with proposals for interventions that legitimize us as an inclusive education in fact.

Considering the current legislation and all the research and studies that corroborate for the advancement in this area, we can conclude that students with High Skills have, guaranteed by law, the right to AEE in regular schools to develop their skills and potentialities. Consequently, the present research has as a study leading question a 16-year-old adolescent with High Skills and tendency to Computational Thinking and his educational school and domestic care, aiming to reflect on this service in the light of legislation and literature related to the area in progress.

Theoretical framework

Individuals who have HS/GT are, according to the National Council of Education: “those who have a high potential and great involvement with the areas of human knowledge, isolated or combined: intellectual, leadership, psychomotor, arts and creativity” (Brazil, 2009, art. 3). In this way, it is necessary activities of curricular enrichment for the certain group that has a gifted behavior.

Renzulli (2014) takes as reference the curricular enrichment to contribute to the development of new skills and creation of new products. For this reason, the theorist indicates three types of curriculum enrichment, which is called the Triadic model. The enrichment of "Type I" aims to put the student in contact with several school subjects, themes, occupations, and *hobbies*. In this case, the student will be able to discover what he likes and develops new skills.

The second is "Type II", which aims to encourage the process of thought and feelings:

This general type II enrichment includes the development of (a) creative thinking and problem solving and affective processes; (b) a wide variety of learning skills specific to the learning type; (c) skills in the appropriate use of advanced-level research and reference materials; and (d) written, oral, and visual communication skills (Renzulli, 2014, p. 546).

The "Type III" aims to encourage the student's interest, that is, to encourage the intelligence that the student has as prevalent. The teacher will have knowledge of these skills because, through the Triadic Model, the teacher will know how to identify which intelligence stands out in the student. This model aims to know how to recognize gifted students and guide them to receive suitable care, according to the student's intelligence.

Renzulli (2014) classifies Giftedness into two categories: academic and productive-creative. Academic Giftedness corresponds to when the student stands out in the classroom or at the university. Productive-creative giftedness is about creating original products. In Computational Thinking, the presence of two intelligences is observed since the person needs to have logical-mathematical thinking to solve a category of problems and creativity to seek new ways of solving issues. In this context, we can see the importance of the school encouraging the student to work with curriculum enrichment.

Gardner's concept of intelligence is:

As a biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are valued in a culture. This modest modification of the utterance is important because it suggests that intelligences are not objects that can be seen and counted. They are potential – presumably neural – that may or may not be activated, depending on the values of a specific culture, the available opportunities in that culture, and the personal decisions made by individuals and/or their families, their teachers, and others (Gardner, 2000, p. 47).

Gardner (2000) and Renzulli (2014) agree on the importance of students with gifted behaviors having curriculum enrichment. It is important to encourage students' creativity because only through it will be possible to create new products.

As for the concept of creativity, there is much debate about its real meaning. Guiding the collective imagination, it always appears as the ability to create and innovate. For Csikszentmihalyi (1996 *apud* Renzulli, 2014, p. 282): "creativity is used for people who experience the world in new and original ways. Their perceptions are vibrant and their judgments perceptive." In this way, we understand that creativity is *a sine qua non* condition to produce knowledge and goes through all stages of the process of building something, from the initial idea to the materiality of what is created.

Regarding Computational Thinking, creativity is present in the four pillars of the methodology – decomposition, pattern recognition, abstraction, and algorithmic thinking – adding value and legitimacy, as new forms of the use of technology are included and added to what is produced. Therefore, Computational Thinking in school environment encourages creativity by strengthening the "I" of students and promote the creation of new products related to technology.

Although its development is associated with computer science, Computational Thinking can be used across several areas of knowledge. Logical-mathematical intelligence is preponderant in Computational Thinking, since it concerns the development of abstract thinking: "[...] the person is able to build an algorithm, which is nothing more than a computational solution, a step-by-step process for solving the problem, which can be done computationally or not" (Rodrigues & Souza, 2021, p. 117).

Therefore, it is important for students with High Skills in logical-mathematical intelligence to have a curriculum enrichment in Computational Thinking, as it will encourage the student's creativity. In addition, the result of school enrichment is a greater involvement with the task and the creation of new products.

To re-signify the education of the gifted, it should be noted that, in accordance with Decree No. 7,611 of 2011 (Brazil, 2011), the AEE aimed to HS/GT people and has a supplementary nature. In other words, it aims to offer a range of knowledge and activities that allow the student to broaden and deepen their knowledge about one or more areas of knowledge. In this place, the student is a protagonist and has the possibility to develop his autonomy and research spirit. The teacher plays the role of a facilitator, a professional who will help to promote knowledge, carrying out timely and constructive interventions (Machado & Queiroz, 2021).

According to a study carried out by Machado and Queiroz (2021), AEE provides students with HS/GT the expansion of knowledge and development of their potential, in

addition to the discovery of other areas of creative potential that can grow. It is an enrichment curriculum resource capable of playing a decisive role in the future of students, since it can discover and deepen skills that, if not exposed to certain activities, could be submerged. Therefore, providing spaces for knowledge with this scope of work is essential for the development of individuals in school years.

About this, Sabatella points out that:

Suitable education for people with HS/GT has the potential to change their lives, because, when exposed to new content and challenges, they tend to feel more motivated, breaking with the demotivating cycle of school education with a strict and unattractive curriculum and, thus, develop their potential and they are happier in their achievements (Sabatella, 2013 *apud* Machado & Queiroz, 2021, p. 58).

Finally, it should be noted that: "inclusion requires the socialization and development of all students present in the classroom" (Dias, Fernandes & Salgado, 2021, p. 24). Therefore, the investigative and attentive eye of teachers should also be towards those students who present higher development than their age peers. In addition, it should inquire and instigate these curious students who always present unexpected solutions and answers to the propositions made inside and outside the classroom.

Methodology

It refers to a qualitative case study that analyzed the educational and work path reported by an adolescent with High Skills with Computational Thinking through the application of a survey. For this purpose, the content analysis of Bardin (2016) was used and, to carry out the research, an authorization term was requested from the adolescent's legal guardian.

First, a literature search was carried out in the *SciELO*, *Google Scholar* and *Pepsico* databases, regarding the conceptions of High Skills and Computational Thinking and AEE for students with HS/GT. In addition, the current legislation dealing with AEE for students with High Skills was analyzed.

In face of the study, a reflection was indicated on the convergence between what is proposed by current legislation and the theories applied to the area, combined with the reading that the adolescent does regarding his passage through regular school and how these schools did not meet his needs and desires, while the support received from his family was preeminent. For such, we will use the content analysis proposed by Bardin (2016) to deal with the obtained data.

In the second part of this work - whose proposed pattern for this study is formed by a survey which was answered by the student - it was developed a case study where the following questions were applied:

Table 1 Research questions

QUESTIONS
How and when were you diagnosed with HS/GT?
What are your parents and the school reaction?
*How was your school life? Have you received any support regarding HS/GT?
*Tell us a bit about your career in programming.
*Is creativity an important factor in the development of your work? Talk a little about it.
*How was the experience with ENEM?
* What are your current work projects?
Notes

Source: Table built by the authors (2022).

Results

The interviewee started programming at the age of eight and was identified with High Skills at the age of nine and then advanced one year in elementary school. It was not enough for his socio-emotional and cognitive adjustment as he did not feel part of the class, he did not identify with the contents, and he thought everything was easy, due to his degree of maturity. Upon entering High School, he undertook a series of assessments that enabled him to attend three High School years in one year. Currently, he is 16 years old and enrolled in the Computer Science program at Universidade Federal Fluminense.

Although he was reclassified twice in the schools in which he studied, he did not receive support for developing his skills. This report corroborates with authors researched by Remoli and Capellini (2017) in which it was observed that Brazilian education, although it has resources, still does not meet HS/GT students in the same way as it meets students with disabilities. Most students with HS/GT have a school life without being identified and schools still have a large gap in terms of encouraging and developing students with High Skills. He states that: "Unfortunately I did not have any support regarding my High Skills in any of the schools, I had to lead myself to improve my skills the best I could¹". In addition, he states, he always relied on his family to develop his skill.

In this perspective, we found, in Landau, reflection of the importance of supporting in the education of students with High Skills, as reported by the interviewee. For the author:

¹ Verbal information. Participant with fictitious name. Antônio Interview. 2022. Rio de Janeiro 2022.

While intellectual support provides information, meaning, and training for challenges, the environment provides the motivation for the child to effectively realize his or her full age potential. This way, from the connection of influence of these factors, giftedness can bloom (Landau, 2002 *apud* Soares, Lacerda & Alves, 2021).

Regarding the report of high ability, he states that his family reacted calmly and that he had and has all the necessary support for his development. According to Silva and Fleith (2008 *apud* Remoli & Capellini, 2017), family influence is a relevant aspect in terms of encouragement to HS/GT to provide challenges and all the necessary support to promote the identity development of these individuals. This support was essential, since he has already attended in the project of pedagogical workshops, entitled "Factory Floor", at the Solange Dreux Special School, he is fluent in English, he has in-depth knowledge in: "complex programming languages, such as *Javascript* [...] and task automation and data management system with *Pythor*²".

As far as programming is concerned, the interviewee reports that he has always been interested in the area and he has always been encouraged by his family to carry out activities in the technological environment. He has been studying programming since he was eight years old, developing digital games in 2D platforms such as *Scratch* and *Construct2*. The use of these resources has encouraged and powered his logical thinking and led him to programming logic. Therefore, Ribeiro *et al.* (2021) states that when:

The student, supported since the core of computing thought, can develop different skills, such as the ability to analyze, to read, to understand important parts of a question, and it also allows a connection between multiple knowledge and skills (Ribeiro *et al.*, 2021, p. 03).

The versatility of the programming universe made it possible for the interviewee to migrate his performance to computational languages, creating projects in several areas of computing, such as task automation and Python data management system, having his first job with a salary when he was 13 years old. His current work consists of creating: "*websites* focusing on modern interfaces and users experience³".

Logical-mathematical intelligence was a factor approached by the interviewee as being of great relevance in the performance of his tasks. According to him, the understanding of programming logic was a major factor, highlighting the algorithms concepts, block diagrams, variables, decision structures and repetition as necessary for

² Verbal information. Participant with fictitious name. Antônio Interview. 2022. Rio de Janeiro 2022

³ Verbal information. Participant with fictitious name. Antônio Interview. 2022. Rio de Janeiro 2022.

his performance. In this context, according to authors researched by Quadros, Bicho and Adamatti (2020) as the person develops and increases Computational Thinking, intelligence tends to increase as well.

Regarding to creativity, the interviewee takes a prominent approach. He reports that creativity is not only related to an innovative idea for creating a product. In fact, it is present throughout the entire process of creation. He reports that many products are innovative but have confusing functionality and that it is not accessible to any type of person. He approaches creativity as a necessary “tool” for the development of programming work. Therefore, he points out that:

At the beginning of my career as a programmer, I always thought that an innovative idea was necessary for any project I was going to create, but over time, I found out that things are not like this. Unlike to what many believe, the creativity of a project in the technological area is not only present in the idea, but in the entire context of the system, whether in the interface, usage, or innovations in the code itself⁴.

Still on this point, the adolescent highlights that the lack of encouragement and dissemination of scientific Olympics in schools makes it difficult to discover new talents. On the other hand, the promotion and encouragement for the attendance of students in these events corroborates the development of talents that, most of the time, is the responsibility of the family.

The emphasis given by the interviewee to the importance of curriculum enrichment corroborates both, the laws, and the care of gifted students. According to Resolution No. 4 of 2009 (Brazil, 2009), which establishes the National Guidelines for AEE in Basic Education, students with High Skills will have their curriculum enrichment activities in public schools. This forecast is in line with the PNE strategy 4.4, which provides on the guarantee of:

Ensure specialized educational care in multifunctional resource rooms, classrooms, schools, or specialized services, public or affiliated, in complementary and supplementary forms, to all students with disabilities, global developmental disorders and high skills or giftedness, enrolled in the public basic education schools, according to the need identified through evaluation, after listening to the family and the student (Brazil, 2014).

It is the duty of the State to ensure, according to art. 4, item III, of Law No. 9.394/96 (Brazil, 1996), the free AEE for students with HS/GT in the regular education school, as well

⁴ Verbal information. Participant with fictitious name. Antônio. Interview. [2022]. Rio de Janeiro, 2022.

as provided for in art. 9, item IV – when it states the responsibility upon the Federal Government, in partnership with the federated entities –, to establish guidelines for the care of HS/GT students. Also on the Law, art. 59, item I, provides that education systems should ensure to students with HS/GT: “curricula, methods, techniques, educational resources and specific organization, to meet their needs” (Brazil, 1996).

The interviewee's hard-hitting report regarding the lack of care for students with HS/GT is also expressed in the statistical data. According to the 2021 Census (Brazil, 2021), we have enrolled a number far below the expected number of students with HS/GT. This data brings a warning: if we have only 23,758 reported students with HS/GT, for a total of 46.7 million students enrolled, the reality of AEE for this public is far below what the legislation provides.

Therefore, all this tangle of knowledge, data and reports reveals the harsh reality of a student with HS/GT in Brazil, which is to be an individual of rights, but which is not effectively guaranteed because they are not identified. Therefore, it is understood that it is necessary to disseminate knowledge about HS/GT on a large scale and teacher training in the area – since it is the teacher who works directly with these students, and he/she has the possibility to identify and meet their needs and opportunities.

Final remarks

Although there is a range of laws and decrees that testify in favor of caring for people with specific needs, with a focus on HS/GT people in this study, it is still observed that most students with HS/GT are not identified and granted by AEE.

A significant analysis that the research presents is the fact that we have few studies that address the theme – AEE in HS/GT – and the lack of incentive by educational institutions for the development of Computational Thinking in schools and the identification of students with HS/GT and their care in AEE.

However, studies show that, when properly encouraged, with provocative, creative, and unusual activities, students with HS/GT tend to develop fully within their abilities, as is the case of the adolescent object of the research. Although he did not receive AEE in the schools in which he studied, he had unrestricted support from his family, which made it possible to have, at the age of 16, been accepted to the Computer Science program at a Federal University and he already works in programming area.

Consequently, this fact demonstrates that, if schools had stimuli more directed to student's skills and potential and invested in the identification of HS/GT, the number of cases such as that of the adolescent interviewed would be much higher than that

presented today. This leads to the reflection that if we do not change our view of these students, we will continue to keep talents submerged in schools and society.

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RESUMO:

Estudantes com Altas Habilidades/Superdotação constituem um número expressivo nas classes escolares, embora sejam invisibilizados pela comunidade escolar. Com o objetivo de expandir as reflexões acerca dessa temática, esse trabalho apresenta um estudo de caso sobre um adolescente diagnosticado com Altas Habilidades e que apresenta Pensamento Computacional. Trata-se de uma pesquisa bibliográfica e qualitativa, em que foi aplicado ao adolescente um questionário contendo sete perguntas e um campo para observações. Os resultados obtidos apontam para um dado sensível de falta de Atendimento Educacional Especializado para os alunos com Altas Habilidades/Superdotação nos espaços escolares. Isso nos leva a concluir que estamos perdendo a possibilidade de encontrar, estimular e desenvolver talentos e potenciais nesses estudantes.

PALAVRAS-CHAVE6+: Altas Habilidades ou Superdotação; Atendimento Educacional Especializado; Pensamento Computacional.

RESUMEN:

Los estudiantes con Altas Habilidades/Superdotación constituyen un número significativo en las clases escolares, aunque son invisibilizados por la comunidad escolar. Con el objetivo de ampliar las reflexiones sobre este tema, este trabajo presenta un estudio de caso sobre un adolescente diagnosticado con Altas Habilidades y que presenta Pensamiento Computacional. Se trata de una investigación bibliográfica y cualitativa, en la que se aplicó al adolescente un cuestionario que contenía siete preguntas y un campo de observaciones. Los resultados obtenidos apuntan a una carencia sensible de Atención Educativa Especializada para alumnos con Altas Capacidades/Superdotación en los espacios escolares. Esto nos lleva a concluir que estamos perdiendo la posibilidad de encontrar, estimular y desarrollar talentos y potencialidades en estos estudiantes.

PALABRAS CLAVE: Altas Habilidades o Superdotación; Asistencia Educativa Especializada; Pensamiento Computacional.