

**Educational robotics and inclusion of gifted students:  
a challenge in school routine**

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**Abstract**

The manipulation of technological objects towards reworking, rebuilding and reinventing them to solve everyday problems leads the student to exceed the role of user of technology, becoming aware of technology in all its aspects, including in their political and social dimensions. Educational robotics allows the elaboration of activities presented in the form of challenges that students should strive to solve. These challenges, when inspired by problems of their own school or neighborhood, make students feel participating, contributing to improving the quality of life in their surroundings. The use of educational robotics offers the student the opportunity to see their “invention” materialized into a finished product, encouraging him to “create” practical solutions to everyday problems. The student tries ways of building knowledge in an interdisciplinary approach that invokes, not only the school teaching but also additional knowledge in various fields. We address educational robotics as an effective approach to stimulate the autonomy and creativity of gifted children.

## **The daily life of the gifted student: instabilities in legislation and misunderstandings in the classroom**

In Brazil, giftedness is still seen as a rare phenomenon and the proof of that is the amazement and curiosity towards a child or teenager diagnosed as gifted. It is observed that there are many erroneous ideas about gifts in popular thought. Ignorance, prejudice and tradition keep alive a number of ideas that interfere and hinder an education that promotes better development of students with high abilities.<sup>1</sup> (ALENCAR, 2007, p. 15)

Giftedness is not a rare phenomenon as think many professionals in basic or higher education. The major problem is that, in Brazil, official data on the amount of gifted students exist, but are outdated. This can be related to the lack of discussion on this theme in training courses for educators and the scarcity of post-graduate programs geared to this area.

The unfamiliarity and lack of information of education professionals regarding this issue draws attention since there is a long time that Brazilian law recognizes the right of special education for gifted students. The first law regulating the education that refers to the subject of giftedness was the LDB<sup>2</sup> 5692, of 1971, in its 9<sup>th</sup> article:

The students that have physical or mental disabilities, those who are in considerable delay in the age of regular registration and the gifted should receive special treatment, according to the standards set by the Councils of Education<sup>3</sup>. (BRASIL, 1971)

A latter version of 1996, in Chapter V (Art. 58 to Art. 60) cited the word "gifted" in article 59, II, to ensure

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<sup>1</sup> Free translation from Portuguese to English of: "No Brasil, superdotação é ainda vista como um fenômeno raro e a prova disso é o espanto e curiosidade diante de uma criança ou adolescente que tenha sido diagnosticado como superdotado. Observa-se que muitas são as idéias errôneas a seu respeito presentes no pensamento popular. Ignorância, preconceito e tradição mantêm viva uma série de idéias que interferem e dificultam uma educação que promova um melhor desenvolvimento do aluno com altas habilidades".

<sup>2</sup> In Portuguese, Lei de Diretrizes e Bases.

<sup>3</sup> Free translation from Portuguese to English of: "Os alunos que apresentem deficiências físicas ou mentais, os que se encontrem em atraso considerável quanto à idade regular de matrícula e os superdotados deverão receber tratamento especial, de acordo com as normas fixadas pelos competentes Conselhos de Educação".

II - specific terminally for those unable to reach the required for completion of primary school level because of their disabilities; and acceleration in less time to complete the curriculum for the gifted;<sup>4</sup> (BRASIL, 1996)

Despite of having at least one article mentioning explicitly the gifted students, it was not clear who should be included in special education, as we can see in the previous article (art. 58):

Art. 58. It is understood by special education for the purposes of this Law, the type of education preferably offered in the regular school system, for students with special needs. (Original Writing).<sup>5</sup> (BRASIL, 1996)

In other articles of 1996 LDB it was also unclear who were the students with special needs, as Art. 59 which in its original wording: "education systems will ensure to learners with special needs ..."<sup>6</sup> (BRASIL, 1996). As well as the sole paragraph of art. 60

Sole paragraph. The Government will adopt, as preferred alternative, the expansion of services to students with special needs in regular public education, regardless the support to institutions predicted in this article.<sup>7</sup> (BRASIL, 1996)

In addition, chapter III of the 1996 LDB discoursed on students with special needs assuring "free specialized educational services for learners with special needs, preferably in the regular school system"<sup>8</sup> in article 4, section III, (BRASIL, 1996)

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<sup>4</sup> Free translation from Portuguese to English of: "II - terminalidade específica para aqueles que não puderem atingir o nível exigido para a conclusão do ensino fundamental, em virtude de suas deficiências, e aceleração para concluir em menor tempo o programa escolar para os superdotados;"

<sup>5</sup> Free translation from Portuguese to English of: "Art. 58. Entende-se por educação especial, para os efeitos desta Lei, a modalidade de educação escolar, oferecida preferencialmente na rede regular de ensino, para educandos portadores de necessidades especiais. (Redação Original)"

<sup>6</sup> Free translation from Portuguese to English of: "Os sistemas de ensino assegurarão aos educandos com necessidades especiais"

<sup>7</sup> Free translation from Portuguese to English of: "Parágrafo único. O Poder Público adotará, como alternativa preferencial, a ampliação do atendimento aos educandos com necessidades especiais na própria rede pública regular de ensino, independentemente do apoio às instituições previstas neste artigo".

<sup>8</sup> Free translation from Portuguese to English of: "atendimento educacional especializado gratuito aos educandos com necessidades especiais, preferencialmente na rede regular de ensino".

The LDB treated special students as a monolithic group, disregarding the differences, and thus, requiring a careful reading to identify to which types of students the law was referring. However, recent reformulations in this law indicated that this debate is not yet completely understood and stabilized, even in legal instance. The 2013 review went on to name the gifted, identifying them as participants of special education, thus, recognizing the particularities of this group with respect to the whole set of special students. In the new wording of the LDB, students with high ability or giftedness are explicitly mentioned as participants of special education.

Art. 58. It is understood by special education for the purposes of this Law, the type of education offered preferably in the regular school system for students with disabilities, pervasive developmental disorders and high ability or giftedness. (Amended by Law N°. 12,796, 2013).<sup>9</sup> (BRASIL, 2013)

The new wording of LDB explains the issue of high ability or giftedness. It removes the term, “special need students” and “special needs” as can be seen in the new wording of art. 59: “The school systems will ensure to students with disabilities, pervasive developmental disorders and high ability or giftedness...”<sup>10</sup> (BRASIL, 2013). As well as the reworded paragraph of article 60 and item III, chapter III of the article 4:

Single paragraph. The public authority will adopt as the preferred alternative, the expansion of services to students with disabilities, pervasive developmental disorders and high ability or giftedness in the regular public school system itself, regardless of the institutional support provided for this article. (Amended by Law No. 12,796, 2013)<sup>11</sup>

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<sup>9</sup> Free translation from Portuguese to English of: “Art. 58. Entende-se por educação especial, para os efeitos desta Lei, a modalidade de educação escolar oferecida preferencialmente na rede regular de ensino, para educandos com deficiência, transtornos globais do desenvolvimento e altas habilidades ou superdotação”. (Redação dada pela Lei nº 12.796, de 2013).

<sup>10</sup> Free translation from Portuguese to English of: “Os sistemas de ensino assegurarão aos educandos com deficiência, transtornos globais do desenvolvimento e altas habilidades ou superdotação”.

<sup>11</sup> Free translation from Portuguese to English of: “Parágrafo único. O poder público adotará, como alternativa preferencial, a ampliação do atendimento aos educandos com deficiência, transtornos globais do desenvolvimento e altas habilidades ou superdotação na própria rede pública regular de ensino, independentemente do apoio às instituições previstas neste artigo”. (Redação dada pela Lei nº 12.796, de 2013)

III-specialized educational care free to students with disabilities, global development disorders and high skills or giftedness, across all levels, stages and modalities, preferably on regular network of teaching; (Wording by law nº 12,796, 2013)<sup>12</sup>

The fact that the LDB just happened to recognize clearly the gifted students in 2013 indicates the degree of misinformation regarding this theme. Within this panorama, it is understandable that the school environment is unaware of these students and is unprepared to deal with it. Many times, according Delou et al (2012), the school fails in conducting these pupils to reach their potential, resulting in the waste of talent, causing conformity, boredom, failure, anger, school dropouts. To change this situation and make learning enjoyable and stimulating, it is necessary to devote a special attention to these students through educational methods that promote motivation and the desire for searching for knowledge, and lead the student to “learn to learn”. We argue that educational robotics is a strategy to work with gifted students, in order to capture their interest and guide their talent in proposing solutions to problems of their surroundings by the construction of artifacts.

### **Educational robotics: a teaching strategy**

“First of all, I insist on being a man of my time and not a man exiled from it, which is to say, I have nothing against the machines”<sup>13</sup>. The words of the Brazilian educator Paulo Freire, in the 1980s in a small text that answered the question “The machine is in service of whom?”<sup>14</sup> translates the justification of the use of robotics as a teaching resource. If the student lives in a world where computers, robots and electronic technologies are part of everyday life, it is worth investigating strategies by which these didactic resources can contribute in the educational process. The terms “strategy” and

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<sup>12</sup> Free translation from Portuguese to English of: “III - atendimento educacional especializado gratuito aos educandos com deficiência, transtornos globais do desenvolvimento e altas habilidades ou superdotação, transversal a todos os níveis, etapas e modalidades, preferencialmente na rede regular de ensino;” (Redação dada pela Lei nº 12.796, de 2013)

<sup>13</sup> “Em primeiro lugar, faço questão enorme de ser um homem de meu tempo e não um homem exilado dele, o que vale dizer que não tenho nada contra as máquinas.”

<sup>14</sup> In Portuguese: “A Máquina está a serviço de quem?”

“didactic resource” are frequently misused. For the purpose of this paper we consider as didactic resource the material employed to construct the student project, in this case, the robotic kits. We consider as strategies the way student uses the material to provide learning, in this case, educational robotics. In Universidade Federal Fluminense (UFF), there are activities involving gifted students with robotics since the year of 2011. These activities use active teaching method to lead the student to plan, build and program a prototype for a particular purpose.

According to Luckesi (1994), the active teaching method is characterized by:

[...] A) To put the student in a position of experience that has an interest by itself; b) the problem should be challenging, as stimulus for reflection; c) the student must have information and instructions to help him in the search for solutions; d) provisional solutions should be encouraged and organized, with smooth help of the teacher; e) it must be guaranteed the opportunity to put the solutions in the test in order to determine their usefulness for life.<sup>15</sup> (p. 58)

On these bases, the project *House adapted to wheelchair users: a didactic challenge for teaching the gifted* was proposed, with the goal of bringing students to participate in activities at the University including them in a new dynamic of studies. For this, the construction of a prototype house adapted to wheelchair users was adopted as didactic strategy. In addition, the project presents a method that may contribute to enhance the possibilities of gifted students to learn, by encouraging them to "learn to learn". This project is developed in the Professional Master Course of Diversity and Inclusion, a place where transit wheelchair students. Therefore, the topic comes from real situations, and allows exposing the gifted student in a direct contact with the actors who experience these difficulties on a daily basis.

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<sup>15</sup> Free translation from Portuguese to English of: “[...] a) colocar o aluno numa situação de experiência que tenha um interesse por si mesma; b) o problema deve ser desafiante, como estímulo à reflexão; c) o aluno deve dispor de informações e instruções que lhe permitam pesquisar a descoberta de soluções; d) soluções provisórias devem ser incentivadas e ordenadas, com a ajuda discreta do professor; e) deve-se garantir a oportunidade de colocar as soluções à prova, a fim de determinar sua utilidade para a vida”.

Along the project, the activities are preferably in group, but may also occur individually. The group activities are not considered “[...] just as technique, but as basic condition of mental development”<sup>16</sup> (LUCKESI, 1994, p. 58). Collaborative work takes place, not only between student-student, but also between teacher-student, distancing of a teaching attitude where the student is seen as mere "deposit" of knowledge (FREIRE, 1970), and approaching to a teaching attitude proposed by Levy:

[...] The main function of the teacher cannot be a dissemination of knowledge, which is now done in a more effective manner by other means. Its competence should move to encourage learning and thinking. The teacher becomes a facilitator of collective intelligence of groups who are in his charge. Its activity is focused on the monitoring and management of learning: incitement to exchange of knowledge, relational and symbolic mediation, piloting personalized learning paths etc.<sup>17</sup> (1999, p. 170, 171)

Besides the assembly of prototypes, it is necessary to "give life" to the project. Here starts a programming activity, aiming at making the prototype perform an action. The acquisition of a programming language is important for student development, because it enlarges the space of languages in which the student may express his ideas, and his training in translating his reasoning in different languages. According to Vygotsky, “[...] cognitive development occurs through the process of internalization of social interaction with materials provided by the culture”<sup>18</sup>. (SILVA et al, 2004) To enable this contact with the programming language, the project currently uses the Lego Mindstorms NXT 2.0, which has a programming environment based on the “Easy to use” system, where “drag and drop” command blocks. In the future, it is planned to offer the open-source Arduino Platform, with its programming environment based on command

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<sup>16</sup> Free translation from Portuguese to English of: “[...] apenas como técnica, mas condição básica do desenvolvimento mental”

<sup>17</sup> Free translation from Portuguese to English of: “[...] a principal função do professor não pode ser mais ser uma difusão dos conhecimentos, que agora é feita de forma mais eficaz por outros meios. Sua competência deve deslocar-se no sentido de incentivar a aprendizagem e o pensamento. O professor torna-se um animador da Inteligência coletiva dos grupos que estão a seu encargo. Sua atividade será centrada no acompanhamento e na gestão das aprendizagens: o incitamento à troca dos saberes, a mediação relacional e simbólica, a pilotagem personalizada dos percursos de aprendizagem etc”.

<sup>18</sup> Free translation from Portuguese to English of: “[...] o desenvolvimento cognitivo se dá pelo processo de internalização da interação social com materiais fornecidos pela cultura”.

lines. The interaction with two possibly of programming languages kits is important for the intellectual development of the individual. According to Vygotsky, “[...] Language is fundamental to structure the thinking, as it is through it that we communicate knowledge and individual ideas and understand the thinking of others involved in the process.”<sup>19</sup> (SILVA et al, 2004)

The appropriation of the programming language makes the student able to manipulate the technological objects in order to rework, rebuild, reinvent them, to meet local demands. This causes the student to exceed the role of user of technology, becoming aware of the tooling in all its aspects, including in its social and political dimensions. “Viewed critically, the technology is no more than a natural expression of the creative process in which human engage when forming his first instrument to best transform the world”<sup>20</sup>. (FREIRE, 1981, p. 68)

There's a whole creative process behind each task, solution. The project activities seek to enhance the creative process of the student, in order to achieve the main goal of education, that is to “[...] create men who are capable of doing new things, not simply repeating what other generations have done, men who are creative, innovative and discoverers”.<sup>21</sup> (PIAGET, 1996, p. 5 apud KLOC et al, 2009).

Through participant observation in robotic workshops conducted at UFF, we realized that the students that were submitted to a proposal for construction of their own learning and collective interaction developed creative and communicative skills. For this reason, we propose the use of educational robotics as didactic resource for the supplementation of gifted students' studies in an interdisciplinary approach, aiming at the contact of the student with scientific-technological process, and also helping him to understand the world he inhabits.

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<sup>19</sup> Free translation from Portuguese to English of: “[...] a linguagem é fundamental para estruturar o pensamento, pois é por ela que comunicamos o conhecimento e as ideias individuais e entendemos o pensamento do outro envolvido no processo”.

<sup>20</sup> Free translation from Portuguese to English of: “Vista criticamente, a tecnologia não é senão a expressão natural do processo criador em que os seres humanos se engajam no momento em que formam o seu primeiro instrumento com que melhor transformam o mundo”.

<sup>21</sup> Free translation from Portuguese to English of: “[...] criar homens que sejam capazes de fazer coisas novas, e não simplesmente repetir o que outras gerações já fizeram, homens que sejam criativos, inovadores e descobridores”



## **Conclusion**

The project *House adapted to wheelchair users: a didactic challenge for teaching the gifted* was designed to give these students the opportunity to experience a dynamic of studies in the university different from what they usually live in their school environments. It aims at stimulating, autonomy, collaborativity and the learning through experiences.

At present, the work of construction of the house is still in the early stages, with a limited data collected from the participation of four gifted children of basic education. But it can already be seen an increasing commitment of these children in learning new content, more satisfaction in learning and pleasure in participating in activities at the university.

Using the technique of participant observation for collecting data, we noted the development of students in their communication and social skills. At a first moment, the students tried to solve all the steps alone. Then, along the course of the project, they began to interact with everyone involved in the project, to share achievements and ask for help.

The observations also showed that robotics awakens efforts to correlate activities with some school subjects. As an example, when constructing a bathroom sink adapted to wheelchair users, students adopted concepts that they were still studying. They also started to predict concepts that they had not yet started to study in school, such as angles, strength and speed. To further consolidation of data, we plan to perform interviews with students, teachers and parents.

This project, besides validating and encouraging skills, creativity and curiosities to facilitate acceptance and potential development, aims at the education of citizens, committed to social issues. In this present case we are focusing the difficulties of the wheelchair user. In the future, this project can bring fruits, such as creating projects of accessibility and inclusive spaces from prototypes of students.

## **References**

Alencar, Eunice M. L. Soriano de (2007). *Indivíduos com Altas Habilidades/Superdotação: Clarificando Conceitos, Desfazendo Idéias Errôneas*. Fleith,

Denise de Souza (org) A construção de práticas educacionais para alunos com altas habilidades/superdotação: volume 1: orientação a professores. Org. Denise de Souza Fleith. - Brasília: Min. da Ed., Sec. de Ed. Esp.

Brasil (1971). Ministério da Educação. Lei de Diretrizes e Bases da Educação Nacional. LDB 5.692, de 11 de agosto de 1971.

Brasil (1996). Ministério da Educação. Lei de Diretrizes e Bases da Educação Nacional. LDB 9.394, de 20 de dezembro de 1996.

Brasil (2013). Ministério da Educação. Lei de Diretrizes e Bases da Educação Nacional. LDB 9.394, de 20 de dezembro de 1996, alterada pela Lei nº 12.796, de 4 de abril de 2013.

Delou, Cristina Maria Carvalho; Pereira, Eduardo Erick de Oliveira; Mello, Jaqueline Quince de; Marinho, Lourena Pinheiro; Mariani, Ruth Maria; Castro, Helena Carla (2012). Robótica na Educação: Contribuindo para o ensino-aprendizagem de superdotados. In: Anais do V Encontro Nacional do CONBRASD, Rio de Janeiro.

Freire, Paulo (1970). Pedagogia do Oprimido. São Paulo, Editora Paz e Terra.

Freire, Paulo (1981). Ação cultural para a liberdade e outros escritos. São Paulo, Editora Paz e Terra.

Freire, Paulo (1984). A máquina está a serviço de quem?, In: Revista Bits, p. 6.

Kloc, Antonio Eduardo; koscianski, André; pilatti, Luiz Alberto (2009). Robótica: uma ferramenta pedagógica no campo da Computação. In: I Simpósio Nacional de Ensino de Ciência e Tecnologia. Resumos. Paraná.

Lévy, Pierre (1999). *Cibercultura*: tradução de Carlos Irineu da Costa. São Paulo, Editora 34.

Luckesi, Cipriano Carlos (1994). *Filosofia da educação*. São Paulo, Editora Cortez.

Silva, Alzira Ferreira da; Guerreiro, Ana Maria G.; Agaé, Akynara; Pitta, Renata; Gonçalves, Luiz Marcos G.; Aranibar; Dennis Barrios. (2004) *Utilização da Teoria de Vygotsky em Robótica Educativa*. In: Conference'04, Month 1–2.