Education 2030 Agenda targets: Implementing neuroscience findings

Significant progress has been made in ensuring the right to basic education since 2000, under the Education for All (EFA) and the Millennium Development Goals (MDG) frameworks.

Author/s:

Vivian Reigosa Crespo
Senior Researcher and Deputy Director General, Cuban Center for Neuroscience, Havana University, Cuba

Theme/s:

Future of education and learning

This report arises from Science of Learning Fellowships funded by the International Brain Research Organization (IBRO) in partnership with the International Bureau of Education (IBE) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The IBRO/IBE-UNESCO Science of Learning Fellowship aims to support and translate key neuroscience research on learning and the brain to educators, policy makers, and governments.

Executive summary

- Many developments in the neuroscience of learning constitute a "usable knowledge" for education. Educators and scientists can develop neurocognitive interventions for typical and atypical learners for improving literacy, numeracy, reasoning, and many other skills.
- A school-based program for enhancing neurocognitive development may constitute an opportunity to bridge the gap between neuroscience findings and education policies and practices. This affirmation is supported by the key features of the approach: the classroom as an optimal setting for developing neurocognitive interventions, intensive use of Information and Communication Technologies (ICT) facilities, teachers' training in neuroscience and ICT, and promotion of an inclusive intervention that is theoretically guided and reinforced by evidence.
- The implementation of school-based programs for enhancing neurocognitive development in young and old learners may be a useful strategy on the long road to achieve the targets of the Education 2030 Agenda.

Background

Significant progress has been made in ensuring the right to basic education since 2000, under the Education for All (EFA) and the Millennium Development Goals (MDG) frameworks[1]. However, these goals remain an unfinished endeavour. For this reason, the education agenda was renewed with new aims until 2030 and with the aspiration to effectively address current and future global and national education challenges[2].

Subsequently, at the United Nations Sustainable Development Summit, Member States formally adopted the 2030 Agenda for Sustainable Development. The Agenda recognized the important role of education and the Sustainable Development Goal number 4 (SDG 4) states: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"[3]. With a view to providing guidance towards the accomplishment of the Education 2030 Agenda, the Education 2030 Framework for Action defines 10 targets and proposes ways for implementing these[2].

However, the sustainability of SDG 4 had been questioned because there are important world-related challenges and tensions that place the Education 2030 Agenda at risk. Nonetheless, "New knowledge horizons" are being considered in order to help deal with these difficult and adverse circumstances, and it is no surprise that advances in neuroscience are included[4]. In fact, there is an agreement that developments in neuroscience are increasingly attracting the interest of the education community, as these seek to better understand the interactions between biological processes and human learning. While the potential role of neuroscience to improve teaching and learning practices is generally recognized, the opportunity for such developments to inform education policy is also questioned[4].

Bridging *Education 2030 Agenda* and neuroscience in practice

Teachers are among the best cognitive enhancers in the world, changing students' brains on a daily basis to acquire literacy, numeracy, and reasoning skills[5]. For this main reason, the classroom becomes a suitable setting for interventions based on neuroscience findings for enhancing the learning potential of typical and atypical developing learners.

Why implement a school-based program based on this approach?

Reason #1. Evidence from neuroscience research

Nowadays, there is robust evidence about the existence of specific brain networks responsible for basic capacities which are closely related with maths and learning to read. These neurocognitive capacities may function as part of the "starter kit" for understanding numbers or written words. Their influence on reading and maths achievement continues beyond the first grades of the elementary education (see *"Neurocognition and learning. Challenges for inclusive education"* for more extensive explanation). If these skills fail to develop in a typical manner, this may lead to deleterious effects in the acquisition of higher level reading and maths competences[5].

These findings constitute a very "usable knowledge" derived from neuroscience's research with relevant implications for education. On the one hand, they support the strategy of capitalizing on neurocognitive capacities whenever possible during instruction. On the other hand, using adequate tools, teachers could be sensitive to detecting individual differences in the developmental trajectories of the neurocognitive capacities of their students. Through understanding the underlying processes of learning, educators and neuroscientists could develop neurocognitive interventions for typical and atypical learners to improve literacy, numeracy, reasoning, and many other skills in a collaborative fashion.

Reason #2. Economic impact

Average years of schooling are a particularly incomplete measure of education for comparing the impacts of human capital on the economies of different countries. It implicitly assumes that a year of schooling delivers the same increase in knowledge and skills regardless of the education system. Analysis instead must rely upon cognitive skills measured during the schooling period.

An extended empirical analysis related long-term growth to cognitive skills and other aspects of national economies using an international dataset for 50 countries[6]. In this report, regional growth in real per capita GDP between 1960 and 2000 against average test scores after allowing for differences in initial GDP per capita in 1960 were analysed. The result suggests that, conditional on initial income levels, regional growth over the last four decades is completely described by differences in cognitive skills. Moreover, once information is included regarding cognitive skills, school attainment bears no relation to economic growth. In other words, added years of schooling do not affect growth unless they yield greater achievement[6].

Changing schools and educational institutions is a hard task. Moreover, countries that have attempted reforms of schools often find that the results in terms of student achievement are relatively modest[6]. However, this analysis does provide an indication of the potential gains from developing school-based programs for improving neurocognitive development in learners that may lead to economic growth.

Reason #3. Life outcome impact

It has been widely accepted that difficulties in academic achievement could have a deleterious impact on the life outcomes of children. Learning difficulties are a consequence of multiple factors including pedagogical, environmental, sociocultural, health, and so on. Probably, atypical neurocognitive development—in association, or not, with the other factors previously mentioned—increases the risk of a negative life impact because it is a persistent condition over time and also because it is resistant to traditional pedagogical interventions.

To test this hypothesis, we recently carried out a 10-year follow-up study of children with learning difficulties associated with atypical neurocognitive development (LD/AND) and other children with learning difficulties but with typical neurocognitive development (LD/TND). As reference, we recruited a group of typical learners (Reigosa-Crespo, et al. in preparation). We found that the LD/AND group had more relative risk to scholar dropout, addictive behaviors, early paternity, abortions, and unemployment compared with the typical learners than LD/TND group (see Figure 1). So, the results supported the initial hypothesis and sound a warning about the urgency of early identification and intervention of neurocognitive development deviations.

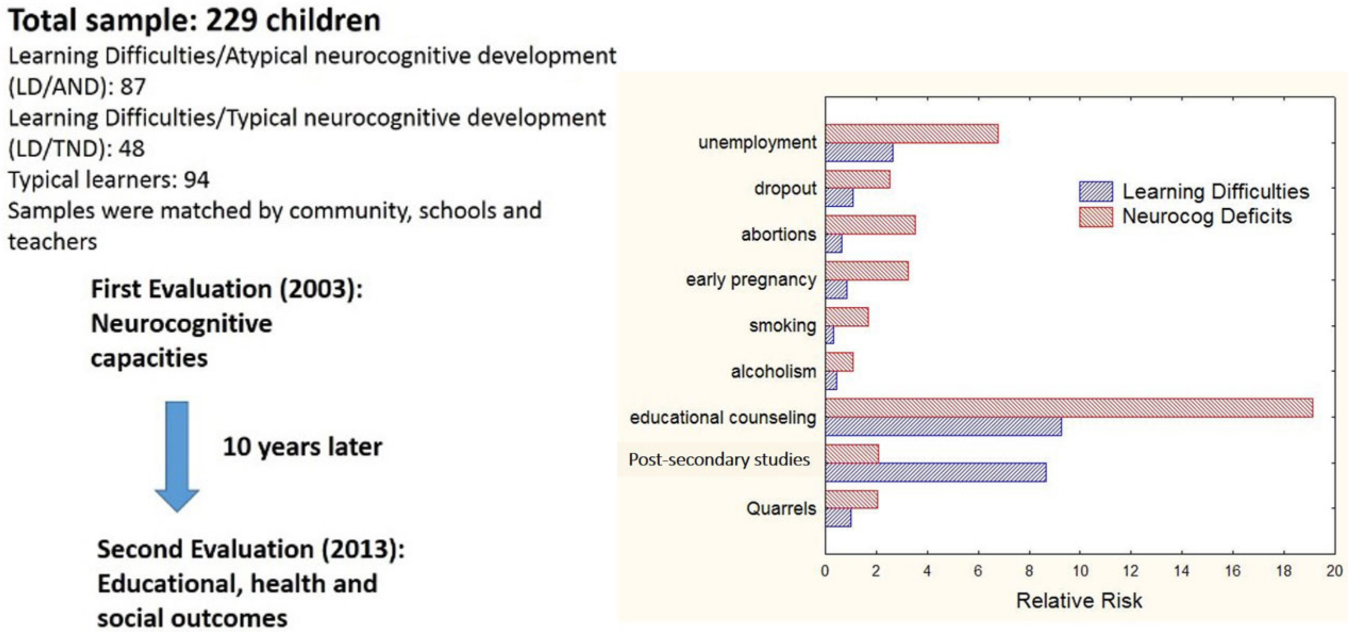

Figure 1. A 10-year follow-up study of children with LD/AND and LD/TND.

Reason #4. *Education 2030 Agenda*'s targets

The *Education 2030 Agenda*'s targets are focused on ten important issues which relate to primary and secondary education, early childhood, technical, vocational, tertiary and adult education, skills for work, equity, literacy and numeracy, sustainable development and global citizenship, education facilities and learning environments, scholarships, and teachers.

The opportunity to implement school-based programs focused on neurocognitive development may have impact on these educational targets, either directly or indirectly. The next section provides arguments for supporting this affirmation.

A proposal

A school-based program focused on neurocognitive development (henceforth, a SBND program) essentially requires tools and sustainable designs fitted to global and local contexts. Researchers of the Educational Neuroscience lab (EN-lab) in the Cuban Centre for Neuroscience have developed tools suitable for SBND programs. These tools are questionnaires for identification of early signs of atypical neurocognitive development and tests for profiling the individual neurocognitive status. This profile may facilitate interventions focusing on individual differences in the classroom.

A SBND program that uses the EN-lab tools has five features:

- A "closed cycle" approach: Red flags-neurocognitive profile-intervention-monitoring
  A "closed cycle" approach means that a SBND program involves: (1) the identification of early signs of atypical neurocognitive development in the learners, (2) profiling of individual differences relative to strengthens and weakness in neurocognitive capacities, (3) personalized intervention in the classroom based on neurocognitive profiles, and (4) monitoring of the student's progress by re-use of the tools for detection and profiling.
- An "ecological" approach: The school is the best place
  The SBND program is conceived to run in schools, avoiding clinical practices that mainly focus on diagnosis and treatment of disorders. Indiscriminate use of these practices can lead to stigmatization and segregation of those with special needs. Under the SBND program, teachers who receive training in neuroscience and ICT can use the screening tools in mobile devices like smartphones or tablets for identifying neurocognitive "red flags" in their students. Based on these early signs and on the information resulting from individual neurocognitive profiles, teachers can elaborate multiple strategies for attending to individual differences in the classroom. This approach supports an "ecological" perspective since SBND programs benefit from the natural conditions of the school environment and teaching-learning interactions. At the same

time, the educational processes and outcomes may be positively impacted as a consequence of these programs.

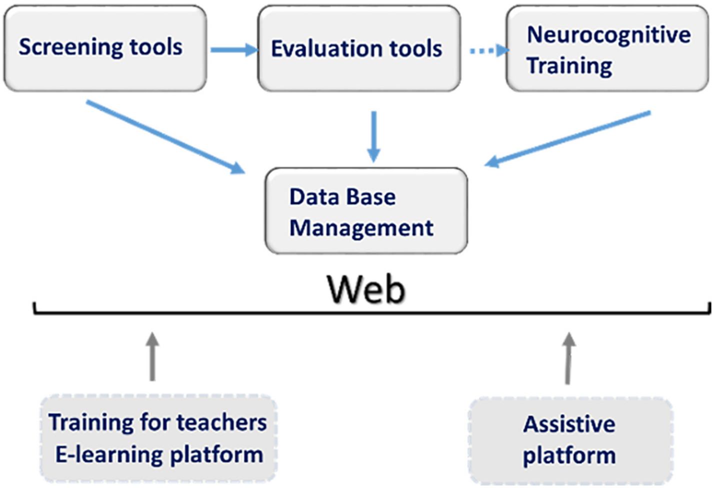

Figure 2. Tools of the school-based programs for improving neurocognitive development are based on ICT facilities.

- Taking advantage of ICT facilities
  As is known, UNESCO and IBE state the integration of ICT into curriculum, teaching, learning, and assessment is a main goal for education until 2030[7]. In line with this endeavour, the SBND programs take advantage of current ICT availability. Tools for detecting "red flags" are based on mobile solutions, whereas tools for profiling neurocognitive development are computerized tests that facilitate precision and accuracy in the assessment. Both have been developed as client-server applications. Teachers' training in educational neuroscience is designed in an e-learning environment (see Figure 2). The intervention includes strategies for attending individual differences in the classroom (see *"Democratizing neuroscience for education"*) and also neurocognitive training using theoretically based videogames (see *"Neurocognition and learning. Challenges for inclusive education"*).

- Teaching to teachers
  A SBND program may drive teacher training in two ways. On one hand, teachers gain knowledge about the neurobiology of learning, the neurocognitive development of learners and its relationship with literacy and numeracy, and also how this knowledge can impact educational practices. On the other hand, teachers acquire skills to use ICT as part of the educational process.

- Inclusive education, then inclusive intervention
  Identifying "red flags" in neurocognitive development may be a powerful way to produce early preschool-based and school-based neurocognitive interventions. However, educators must understand the relationships between the brain, cognition, and learning in order to manage individual differences in neurocognitive development in educational settings. The most effective strategies could be those in which individual differences are seen as opportunities rather than problems that need to be addressed. In this sense, differences can provide opportunities to experiment with strategies that involve all learners in meaningful activities. Cooperative learning is one of them, for example.

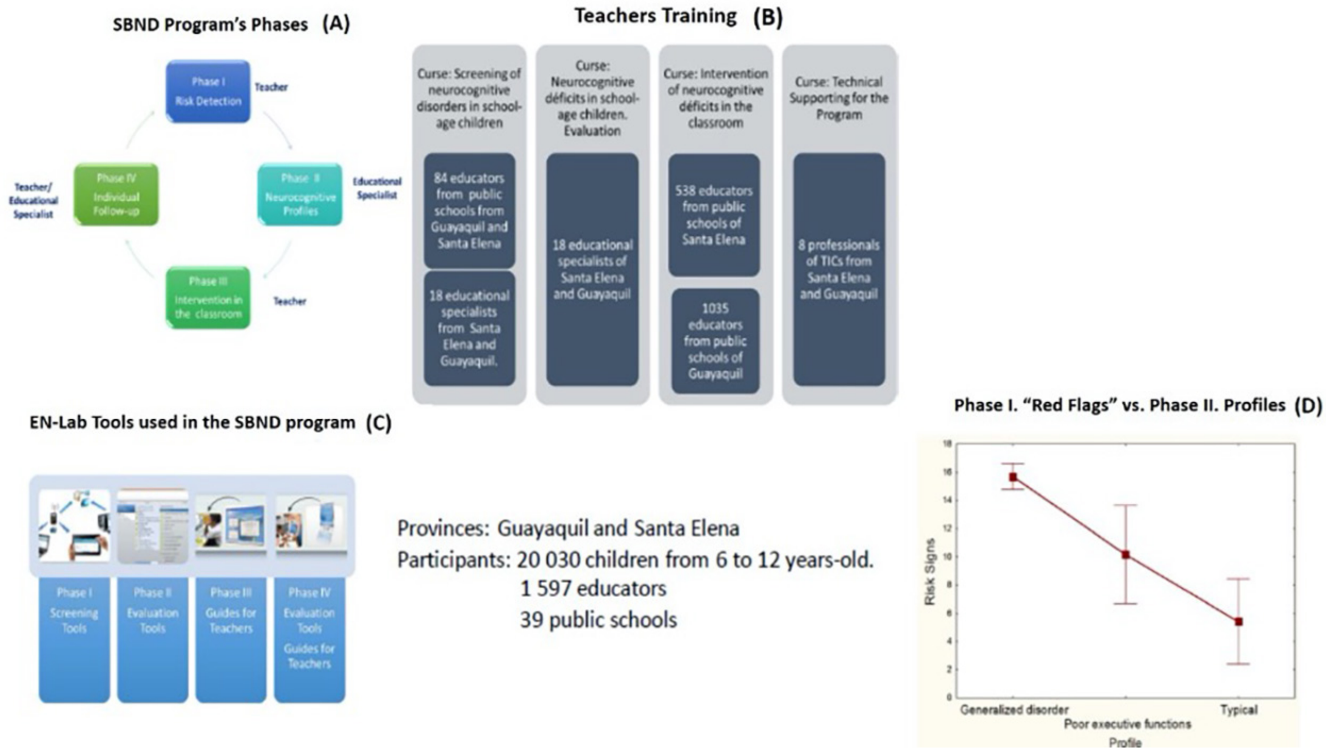

Figure 3. Implementation of a school-based program for neurocognitive development in Ecuador. A pilot study.

An implementation in progress

The Educational Ministry of Ecuador in collaboration with CNEURO is carrying out a pilot study that has recruited 20,030 children and 1,598 teachers, amongst other educational practitioners. The main goal is to evaluate a SBND program. At present, the study is in progress but actions related with training teachers and detection of "red flags" have been concluded. Figure 3 shows: (A) the SBND program's phases, (B) the training courses for teachers, (C) the tools used in each phase of the SBND program, and (D) the relationship between "red flags" identified by teachers and the neurocognitive profiles. In this case, notice that more "red flags" indicate a more atypical profile.

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