The future of measuring children's learning would be in electromagnetic sensors

A pioneering system with sensors created by scientists from Universidad del Rosario promises to identify learning problems in children in real time. The prototype was presented at the World Congress of Medical Physics and Biomedical Engineering.

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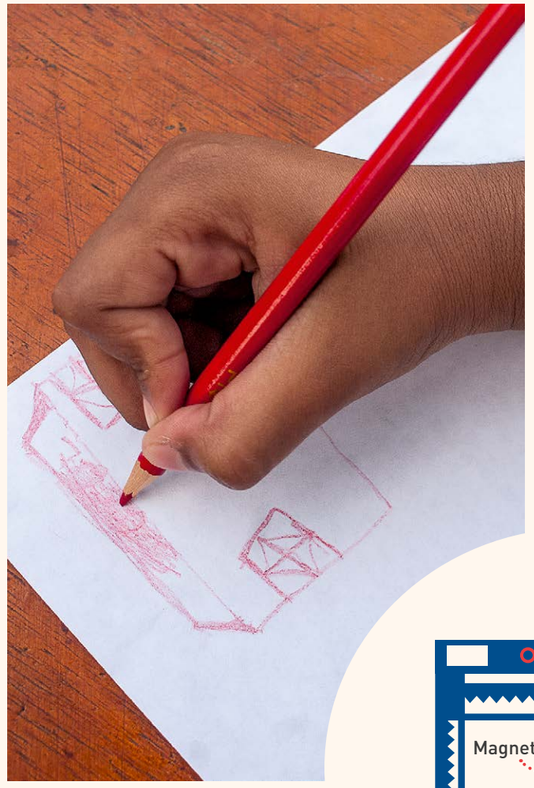
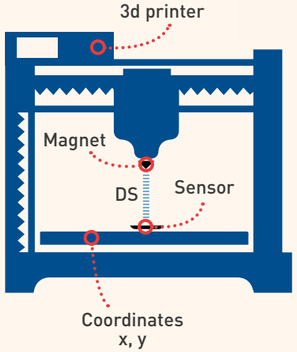
Often, during the learning process, children face cognitive difficulties. To understand these problems, often related to reading and writing, occupational therapists often resort to tests based on direct observations and manual statistical calculations. However, that demands a lot of time and resources and even information can be lost because sometimes, manual records do not incorporate systematized storage. These complexities, in turn, limit the access of vulnerable children to this type of monitoring.

To address this problem, a team of researchers of Universidad del Rosario proposed a technology to identify reading and writing difficulties in children, in an automated way and for little expense. It consists of a system based on electromagnetic sensors that, taking advantage of the Hall effect, accurately assesses patient performance.

The Hall effect is a potential difference (voltage) that is produced in a conductive or semiconductor material, whereby an electric current and a magnetic field are passed through (some sensors use this effect, particularly to measure proximity of another object).



"The device does not seek to replace the pencil or the paper. Our device adapts to the pencil," says the researcher of Universidad del Rosario, Daniel Alejandro Quiroga Torres.



In addition, the project offers the ability to digitally store data collected on a permanent basis, preventing information from being lost with time.

A social necessity

According to UNESCO, six out of 10 children and adolescents present deficiencies in learning competencies. Likewise, an estimated 700 million children and adults in the world are, on account of these deficiencies, at risk of sinking into illiteracy and social exclusion for life.

In that sense, hand-eye coordination is one of the components that affect the reading and writing processes. Therefore, deficiencies in this relationship translate into failures, such as illegible writing and the inversion or disappearance of letters. Most Latin American children do not have access to learning assessments.

The proposed device to solve this problem, created by Daniel Quiroga Torres and members of the research group GiBiome from the School of Medicine and Health Sciences, would help reduce times and costs of literacy standard tests, particularly the one that evaluates eye-hand coordination.

Figure. 1 Diagram of the configuration used in the experiments. The two main metrics are shown: The coordinate system (x, y) and the distance separation (DS).

Disadvantages of the traditional method

Currently, to detect literacy problems The Development Test of Visual Perception (DTVP-3) is used. With it, professionals can measure the degree of visual perception deficit and visual integration (capacity to associate what the eyes see) in children from 4 to 12 years old. This test consists of five major subtests, including an eye-hand coordination test (EHCT).

Quiroga explained to the magazine *Advances in Science* that the EHCT questionnaire consists in using a set of tracks, wherein the child uses a pencil and a sheet to draw strokes along a guided line. If the child leaves the demarcated area or lifts the pencil, their score goes down. Then, the evaluators manually calculate on the basis of standard tables to measure the level at which the infant is. The result, related to their age gives the therapist an insight.

This set of tasks is very time-consuming; even worse, the observation and measurement are not free from errors.

Children's learning according to UNESCO

700
million children run the risk of illiteracy and social exclusion for life owing to some type of learning problems

Many educational systems have little information on the learning conditions of children and adolescents

56%
of all children will not be able to read or handle mathematics with competence when they are older because they do not have access to tools that allow them to detect weaknesses in psychomotor development in time

Six out of 10 children and adolescents will present problems and deficiencies in learning skills

The science behind the learning sensors

To solve these problems, Quiroga's team created a support system based on electromagnetic sensors that take advantage of the Hall effect to measure the results of the questionnaire and the test described above (EHCT and DTVP-3).

It works like this: The user receives a pencil but not just any pencil. It has a magnet, and under the test, there is a matrix of electromagnetic sensors. With the movement of the pencil when drawing, scientists can detect the flow of the magnetic field trace. With this, the system estimates the distances and movements made by the subject.

The magnetized pencil is connected to a digitized system that has an algorithm that calculates the position of the magnet. From this position, it is determined where the magnet is located on the sheet. Using the evaluation criteria of the test, the software automatically calculates whether the pencil position is correct.

Children undergoing the test would not realize everything that goes on behind the scenes: They would be conducting an evaluation as any other. "The device does not seek to replace the pencil or the paper," explained the expert. Writing on a tablet could mean much less precision to detect a trace. Thus, "Our device adapts to the pencil," says the researcher. It should be noted that the prototype detects the position of the pencil with a resolution of 1 millimeter, making it suitable for the evaluation.

"Until now, this type of sensor had not been used for clinical applications," said Quiroga. Similar models with optical sensors were used for the corporate environment although the objective was different: To digitize information taken from electronic notes.

Looking into the future

For now, researchers must define more specific variables to improve performance of the prototype; for example, they must set the most suitable height of the magnet in the pencil because not all children write with the same angle of inclination.

"It is key to identify the ideal space between the sheet and the magnet and the possible angles of inclination to properly correct the model and reach the final version," specified the researcher of Universidad del Rosario.

The innovation will benefit not only therapists of medical centers and private doctors' offices but also educational institutions of the country where the test would be applied massively. Detecting in a timely manner the difficulties in children's learning process will help improve the quality of educational processes.