

Using AI to close the literacy gap a success story by Lexplore and Tobii

About this success story

Reading is an essential element of primary education. Unfortunately, the traditional screening and analysis process is labor-intensive and time-consuming, resulting in some kids falling through the net. Using Al and eye sensor technologies, Lexplore has transformed reading assessment into a rapid PC-based solution that frees up teacher time for remediation and follow-up, helping to close the literacy gap.

About Lexplore

In 2015, Lexplore launched its evidence-based assessment tool that relies on Tobii's eye sensor technology to gauge reading literacy among schoolchildren. Lexplore is a privately-owned Swedish company headquartered in Stockholm — a European hotbed of tech start-ups, innovative ventures, and well-established engineering companies. Currently in scale-up mode, Lexplore are expanding with locations in the UK, the US, Norway, UAE, Ghana, Nigeria, Australia, New Zeeland and Portugal — with Brazil, Germany and France coming soon.

The problem

Reading difficulties hamper a child's capacity to learn. Left undetected, the consequences in adulthood can be highly negative, affecting a person's job prospects and ability to participate in society. In some cases, it can lead to functional illiteracy — which currently affects about 14 percent of the population.

To detect reading difficulties, teachers carry out screenings and analyze the results to identify children who need extra support. They use new research and well-established methods to devise improvement plans, they monitor progress, and follow up. Unfortunately, this process is time-consuming and lacks a systematic approach. And so, without wider investment in additional qualified resources or digital transformation kids will continue to fall through the net.

In addition to the time and resources needed, traditional screening requires a child to read out loud. Teachers rely on manual observation and their experience to make an assessment, which produces subjective and often inconsistent results. As children become more proficient at reading, they develop silent reading skills. Such skills are a better indication of reading ability, but you cannot measure them manually.



The solution — digital transformation

Lexplore uses AI to transform the labor-intensive screening and analysis parts of reading assessment into a digital process. Their innovation not only frees up time for qualified teachers to focus on intervention and follow up, it also raises the value of the outcome because it delivers results based on silent reading.

Eye sensor and cloud computing are the primary technologies enabling the digital transformation of reading-ability assessment.

Enabling Al

The initial research from the 1980s identified a correlation between eye movements and reading capability.

Figure 1 shows how the Lexplore solution instantly translates microscopic eye movements into a reading pattern of fixations (bubbles) and saccades (lines). The size of the fixation indicates how long a person lingers on a word. The larger the bubble, the longer it takes a person to comprehend what's in front of them. The saccades show how a person skips back and forward through a piece of text.



Low Reading Ability



High Reading Ability

Figure 1: Reading patterns generated by Lexplore

The role of sensor and cloud technologies

Eye sensor and cloud computing are the primary technologies enabling the digital transformation of reading-ability assessment.

Eye tracking provides the data input that powers the Lexplore solution. It delivers fixations and saccades, leveraging AI and machine learning techniques to identify the student's eyes and measure how they move.



Figure 2: Tobii's plug-and-play peripheral eye tracker

Lexplore relies on Tobii's plug-and-play peripheral eye trackers to ensure delivery of a reliable data stream of eye movements in real time. All image and signal processing is carried out locally on the specially-architectured Tobii EyeChipTM. And just the necessary high level data points are transferred to the Lexplore solution via the Tobii Stream Engine Interface.

To interpret the student's reading pattern Lexplore uses AI techniques, relying on cloud capabilities for computational processing. The solution combines parameters, such as fixation time, reading speed, and Rapid Automatized Naming (RAN) speed to instantaneously deliver a unique reading-ability score for the student. Scores are anonymized and stored in a secure cloud so that each student can be assigned with a percentile score based on their grade and national average (shown in Figure 3). Visualization uses a 5-color coding system for rapid identification of children in need.



Figure 3: Lexplore percentile score



Enabling capabilities of Tobii eye sensor technology

- Capable of operating at frequencies up to 120z, Tobii's eye trackers deliver the required data granularity to ensure accurate assessment of reading ability.
- Because the eye tracker sits unobtrusively at the bottom of the computer screen and monitors students remotely, it delivers reliable objective data without requiring students to touch or wear a device that might be considered invasive.
- The coverage area of Tobii's eye trackers allows students to sit naturally in front of the computer they don't have to sit still or place their head in a chin rest.
- By performing image and signal processing locally, Tobii eye tracking creates no additional computational load on the host device or cloud services.
- The hardware is compact, plug-and-play, and uses a standard USB interface.
- The small form factor enables Lexplore to ship Tobii eye trackers to schools in the post.



"Tobii's eye trackers just work! It's pretty amazing, we just ship it in the post, the school plugs it in, and it works."

Gustaf Öqvist Seimyr — Lexplore's co founder

Outcome

Cuts time. By transforming a manual process to a digital one, the Lexplore solution massively reduces the amount of time it takes to conduct and analyze screenings. A class of 30 students can be screened and analyzed in a just couple of hours — work which could otherwise take months to complete.

Shifts expertise to the point of need.

The number of qualified teachers who are available to conduct and analyze screenings limits how many students can be processed. By digitalizing this part of the process, the Lexplore solution effectively removes this limitation, enabling teachers to focus on helping students overcome their reading difficulties and follow up on their progress.

Low entry barrier. For digital transformation to be successful, especially in environments like schools, where time is precious, the entry barrier to new systems needs to be as low as possible. The high adoption rate of Lexplore's solution in schools is a direct result of the ease of use of the application, readily understandable visualization of results, and the plug-and-play nature of Tobii's eye tracking peripheral.

Systematic data. Systematic data sets are an essential ingredient for continual assessment and comparison of results at different levels — individual, class, grade, per school, regional and countrywide. Scalable. Manual methods do not scale well. Both the Lexplore application and Tobii eye tracking are PC compatible. By performing image and signal processing locally on the Tobii eye tracker and using cloud processing for data analysis, the overall solution does not require state-of-the-art hardware, making it possible to deliver the Lexplore solution to just about any school with a PC and an internet connection.

Zero test bias. Because eye tracking is an unobtrusive technology, it does not add bias to the assessment process.

Objective data. Eye tracking generates objective data points irrespective of performance on previous tests, relationship with the tester, mother tongue, sex, skin tone, or eye color.

Data-driven decision-making. The insight Lexplore and Tobii eye tracking generate empowers government officials, local councils, schools, and teachers to make effective decisions and appropriate changes at the point of need. Continuous assessment makes it possible to evaluate the impact of changes resulting in improved reading literacy for millions of schoolchildren.

Unexpected value — digital transformation uncovers unknowns

Lexplore set out to transform the screening and analysis part of reading assessment. In doing so, they discovered something new. Experts and teachers are usually proficient at identifying children at either end of the scale — kids with problems and children with above average skills. However, children, especially girls, develop coping methods to cover up perceived shortcomings, which makes it extremely difficult to identify the in-betweeners (stanines 3 and 4 Today the service is used in over 600 schools in nine countries, with an impact on the reading development of some 100,000 students. Many larger organizations have implemented Leplore's service as a mandatory solution, with many interesting AI driven results.

in Figure 3). Eye tracking helps to identify these students because you cannot cheat it. A person can, for example, manipulate their voice or their body language. They can opt not to speak and pretend not to hear, but we cannot control our eye movements to the same extent.

Because of this, the Lexplore solution provides teachers with insight about kids with below average but not low reading ability, allowing them to intervene in cases that may previously have slipped through the net.

At Tobii, we experience this aspect of uncovering the unknown time and again with our partners who encapsulate expertise in an AI system, because this kind of systematic approach often generates new insight.

Bringing AI to assessment

Lexplore has been well received by teachers, parents, schools, and decision makers and is a textbook example of how a manual assessment process can be successfully transformed into a digital one. Al, cloud computing, and eye sensing are the underlying technologies that make this kind of digital transformation possible and deliver systems that dramatically speed up the assessment process, as well as delivering new insights. Freeing up expertise to focus on resolution, we can solve big problems like closing the literacy gap — ensuring a sustainable future for all. Lexplore's innovative solution is ground-breaking for the education world and Tobii is a proud partner.

"The next logical step is for every school computer to have built-in eye tracking... then we could simply make our solution entirely cloud-based. That would be a dream scenario for Lexplore".

Martin Sjöstrand — Lexplore's CEO