ReadLet: an ITC platform for the assessment of reading efficiency in early graders

Reading is not just word decoding, but the joint product of decoding and deep linguistic comprehension [1,2]. Effective linguistic comprehension relies on language skills such as semantic and syntactic awareness. Both decoding and linguistic comprehension are necessary for reading comprehension, and neither is by itself sufficient [2]. However, current protocols for reading assessment measure decoding (reading accuracy and speed) and reading comprehension separately [3,4,5]. This does not allow evaluation of reading efficiency [6], defined as the ability to fully understand connected texts by minimising reading time, a cognitive ability that lies at the roots of students' academic achievement [8,7]. ReadLet is an ICT platform specifically designed to provide accurate, evidence-based assessment of reading efficiency in early grade children, by offering an ecological, non-invasive protocol for extensive data elicitation, storage and analysis.

With ReadLet, early graders at school can read a one or two page text displayed on a tablet touchscreen, either silently or aloud. Children are asked to slide their finger across the words as they read, to guide directional tracking. After reading, the child is prompted with a few multiple-answer questions on text content presented one at a time, while the text remains displayed on the screen for the child to be able to retrieve relevant information. In the process, the tablet keeps track of time-aligned multimodal data: voice recording, finger sliding time, time of reading, time of question answering, and number of correct answers. Data are recorded, stored locally, sent to the ReadLet server through an internet connection, and processed remotely by a battery of cloud-based services, analysing data automatically to produce a detailed quantitative signature of each reading session. A server-based database aggregates anonymised data to make them available for specialists. Also individual's longitudinal profiles are stored, for them be queried and inspected upon authorised access.

The platform combines portable ICT technology and cloud computing with a number of modality-specific software modules, implemented as web services including: i) a text processing and readability assessment service, consisting in a battery of tools for automated linguistic annotation of written texts and a machine-learning component assigning a readability score to annotated texts [9]; ii) a finger touch processing service aligning the child's finger sliding with the written text and measuring speed fluctuations; iii) a speech processing and decoding assessment service, aligning the acoustic record of child's reading with the written text and assessing correctness of recoding [10]. At the time of writing, the platform includes the first two modules only. Preliminary testing of a prototype version of ReadLet technology with a population of about 200 pupils aged 8 to 11, both male and female, varying for socio-economic status, language (Italian, French and Arabic) and geographical area (Italy and Morocco), showed that children are extremely responsive to using a tablet for reading, and very easy to engage in what they perceive as an enjoyable experience. We expect online databases of automatically classified cross-sectional and longitudinal data, accurate statistical modelling and developmental trends of reading literacy to help education professionals and clinical specialists assess the level of reading skills reached by the child, and decide which intervention programmes and measures are most appropriate. While information technology cannot and should not supplant the role and professional judgement of teachers and therapists, the project intends to provide portable tools, models and data for timely screening and daily management of reading difficulties and disorders.

References

1. Gough P B & Tunmer W (1986) Decoding, reading and reading disability. *Remedial and Special Education*, 7: 6-10.

2. Hoover W A & Gough P B (1990) The simple view of reading. *Reading and writing*, 2(2):127–160.

3. Cornoldi C & Colpo G (2012) *Nuove prove di lettura MT per la scuola secondaria di I grado*. Organizzazioni Speciali: Firenze.

4. Shinn M M & Shinn M R (2002) *AIMSweb training workbook: Administration and scoring of reading curriculum-based measurement (R-CBM) for use in general outcome measurement*. Eden Prairie, MN: Edformation, Inc.

5. Wagner R K, Torgesen J K, Rashotte C A & Pearson N A (2009) *TOSREC: Test of Sentence Reading Efficiency and Comprehension*. Austin, TX: Pro-Ed.

6. Cappa C, Giulivi S & Muzio C (2016) L'efficienza di lettura: l' integrazione dell'abilità di comprensione del testo con quella della velocità di lettura. *Proceedings of the XXV AIRIPA National Conference*, Torino.

7. Speece, D., Ritchey, K., Silverman, R., Schatschneider, C., Walker, C., & Andrusik, K. (2010). Identifying children in middle childhood who are at risk for reading problems. *School Psychology Review*, 39, 258–276.

8. García-Madruga, J.A., Vila, J. O., Gómez-Veiga, I., Duque, G., & Elosúa, M.R. (2014). Executive processes, reading comprehension and academic achievement in 3th grade primary students. *Learning and individual differences*, 35: 41–48.

9. Dell'Orletta F, Montemagni S & Venturi G (2011) READ-IT: assessing readability of Italian texts with a view to text simplification. In SLPAT 11 *Proceedings of the Second Workshop on Speech and Language Processing for Assistive Technologies*: 73–83. ACL Stroudsburg, PA, USA.

10. Gerosa, M., Giuliani D., & Brugnara F. (2007). Acoustic variability and automatic recognition of children's speech, *Speech Communication*, 49: 847–860.