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Eye tracking in the classroom: A gaze-enabled reading aid

Tulevaisuuden Labra 6.-7.4.2017, ITK HÄMEENLINNA

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Research Questions

- Can we detect reading and comprehension problems in real-time by measuring eye position for all children in a class…?
- …so that
  - a **summary of the progress** of the class can be displayed to the teacher
  - **automatic help** can be provided as problems arise
  - a record of an **individual child's reading progress** over a number of lessons can be logged and stored

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GaSP

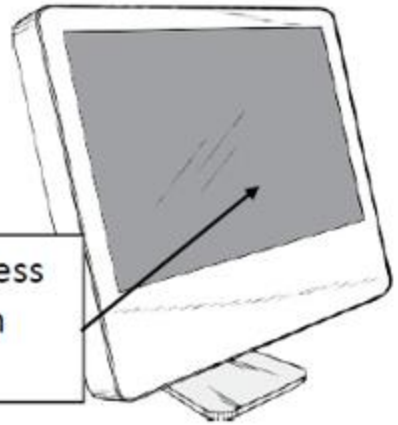
Low-cost gaze aware reading aid

update child's previous reading performance

real time reading analysis

feedback or help if needed

summary of progress from all children in class



eye tracker detects which words are being read

performance update to progress monitor

Approach to testing during reading classes

- 6 children at a time used the system for one lesson
- testing carried out over 4 consecutive lessons in each class
- the teacher identified the text that the class would read during each lesson, which was pre-loaded into the database
- during the lesson, the children with the gaze enabled system read the same text as those reading from books

Estimating reading difficulty from gaze data

- There are several metrics that correlate to the difficulty of reading a word
- The most commonly used is **cumulative fixation duration**, i.e. the sum of the durations of all fixations on a word, including regressions (or revisits) to a word

Calibrating the eye trackers in class

- Clearly the teacher doesn't have time to supervise and check the calibration of the eye tracker used by each child
- A game has been developed that encourages the child to calibrate the device quickly and carefully themselves.


21

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Supporting assumed reading difficulties

- Each child was asked to read two lines of instructions before the class reading began
- The speed of reading these was used to modify the time used to decide when automatic assistance was shown

- Assistance could take several forms. We have used *syllabification*

läntisessä is changed to **län-ti-ses-sä**

Visualisation of reading for teachers

- a number of ways of visualising how different children read were used
  - gaze plot
  - reading durations
  - gaze replay
  - word replay
  - student reading time summary

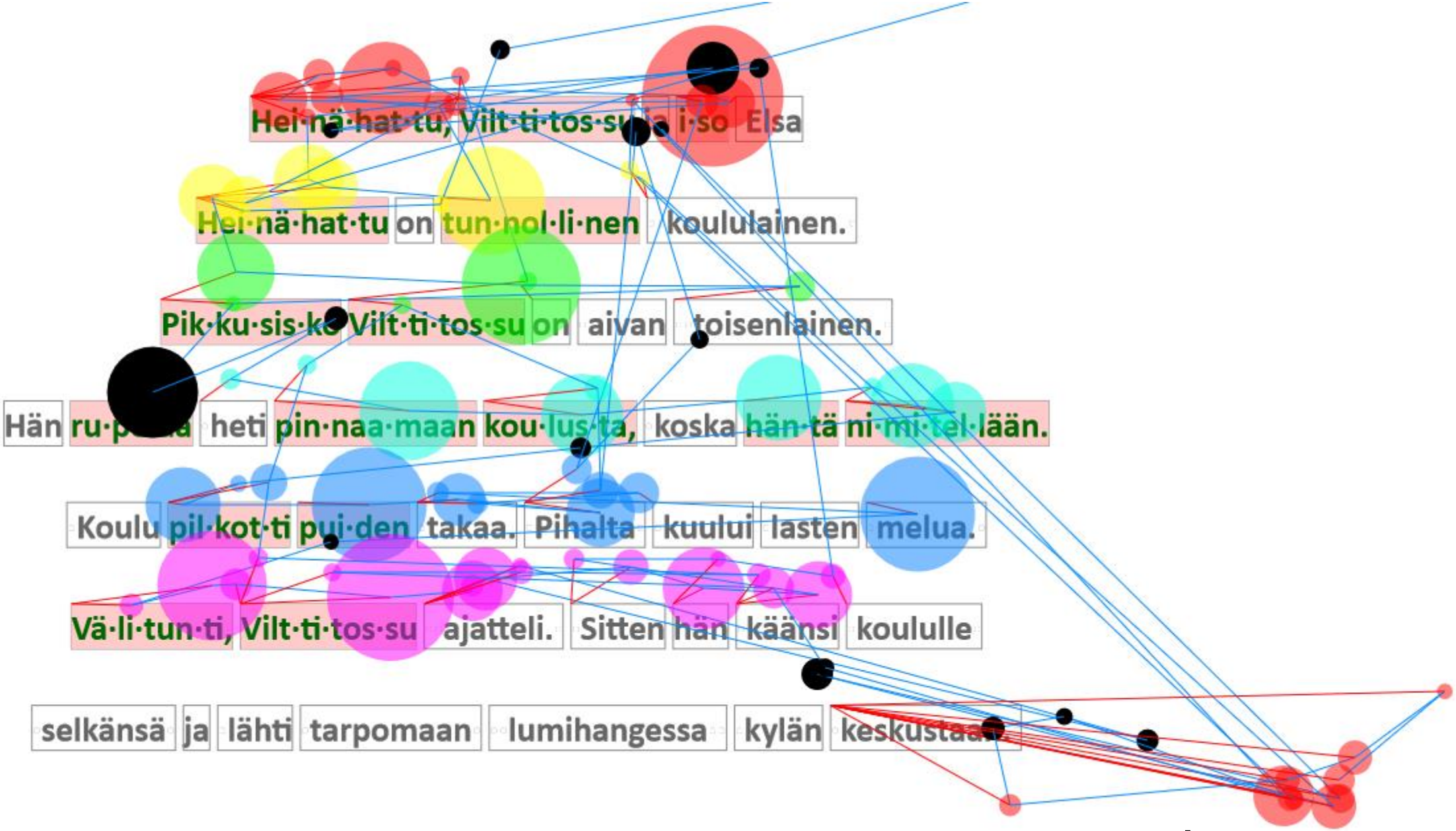
Example of a fairly fast reader (2nd grade)

Gaze plot | Text summary | Gaze replay | Word replay | Student summary

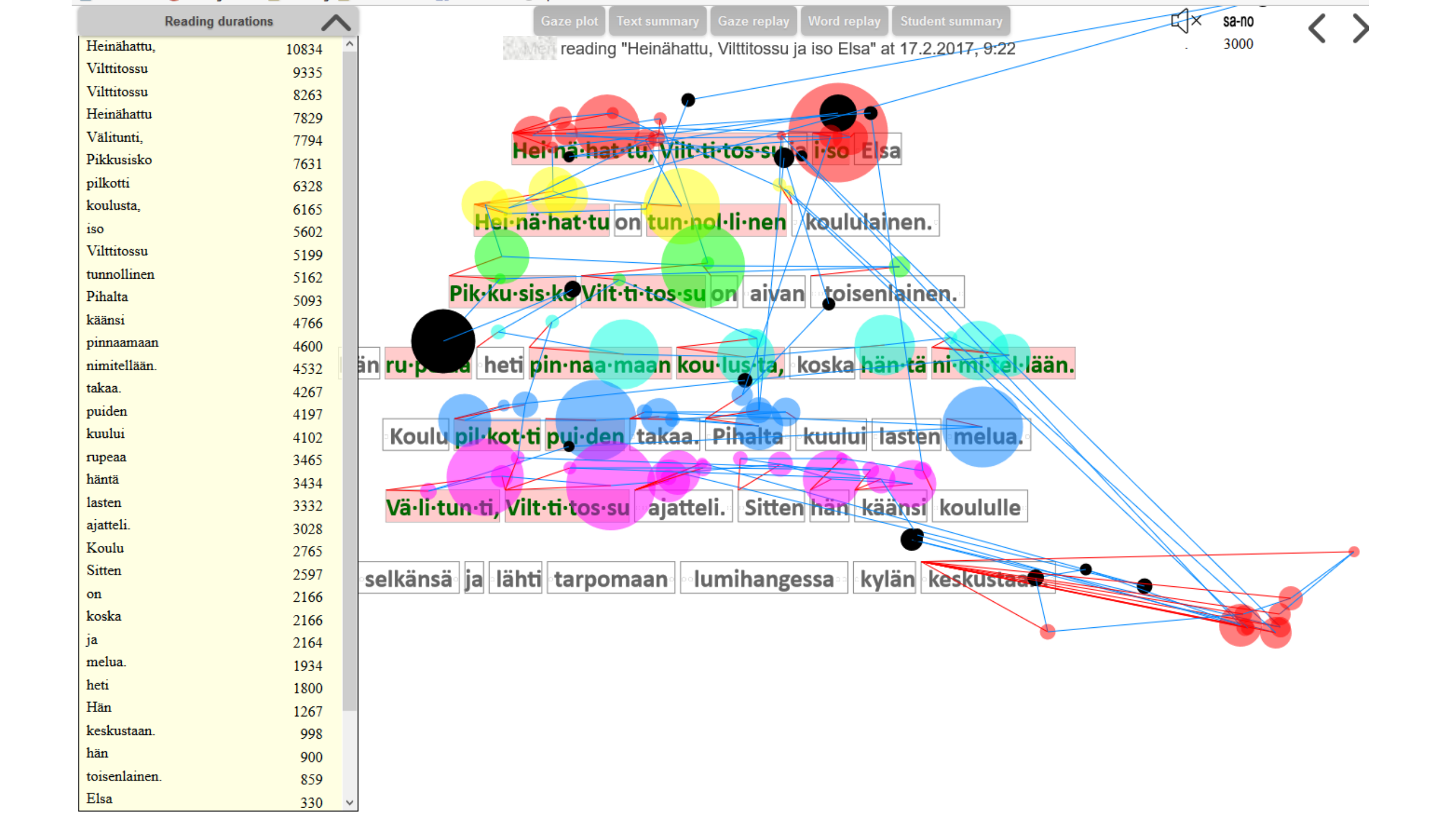
Toblas reading "Muumilaaksossa" at 21.2.2017, 9:18

sa-no
3000

Reading durations	
läntisessä	3598
ullakkohuoneessa.	2366
tekevät	2269
lämpöisimmät	2267
viisaasti,	2163
marraskuussa	2035
pakkasta).	1631
Muumipeikon	1566
saat	1532
peitteet.	1264
otus	1199
niihin	1151
muumipeikkojen	1132
koska	1100
pimeää	1039
laittanut	965
Minä	933
Tiedän,	899
äitinsä	867
nukkua	801
luo	800
kanssa	768
kaikkien	766
tehdä	765
tullut.	733
kaikkein	733
pannut	715
(ja	693
siinä	668
vuoteet	666
Lumi	633
ne	600
Hän	567
oven,	566



Example of a slower reader (2nd grade)


Reading durations
Heinähattu, 10834
Vilttitossu 9335
Vilttitossu 8263
Heinähattu 7829
Välitunti, 7794
Pikkusisko 7631
pilkotti 6328
koulusta, 6165
iso 5602
Vilttitossu 5199
tunnollinen 5162
Pihalta 5093
käänsi 4766
pinnaamaan 4600
nimitellään. 4532
takaa. 4267
puiden 4197
kuului 4102
rupeaa 3465
häntä 3434
lasten 3332
ajatteli. 3028
Koulu 2765
Sitten 2597
on 2166
koska 2166
ja 2164
melua. 1934
heti 1800
Hän 1267
keskustaan. 998
hän 900
toisenlainen. 859
Elsa 330
Gaze plot
Text summary
Gaze replay
Word replay
Student summary
reading "Heinähattu, Vilttitossu ja iso Elsa" at 17.2.2017, 9:22
sa-no
3000
Hei·nä·hat·tu, Vilt·ti·tos·su ja i·so Elsa
Hei·nä·hat·tu on tun·nol·li·nen koululainen.
Pik·ku·sis·ko Vilt·ti·tos·su on aivan toisenlainen.
ru·p
heti pin·naa·maan kou·lus·ta, koska hän·tä ni·mi·tel·lään.
Koulu pil·kot·ti pui·den takaa. Pihalta kuului lasten melua.
Vä·li·tun·ti, Vilt·ti·tos·su ajatteli. Sitten hän käänsi koululle
selkänsä ja lähti tarpomaan lumihangessa kylän
keskustaan.

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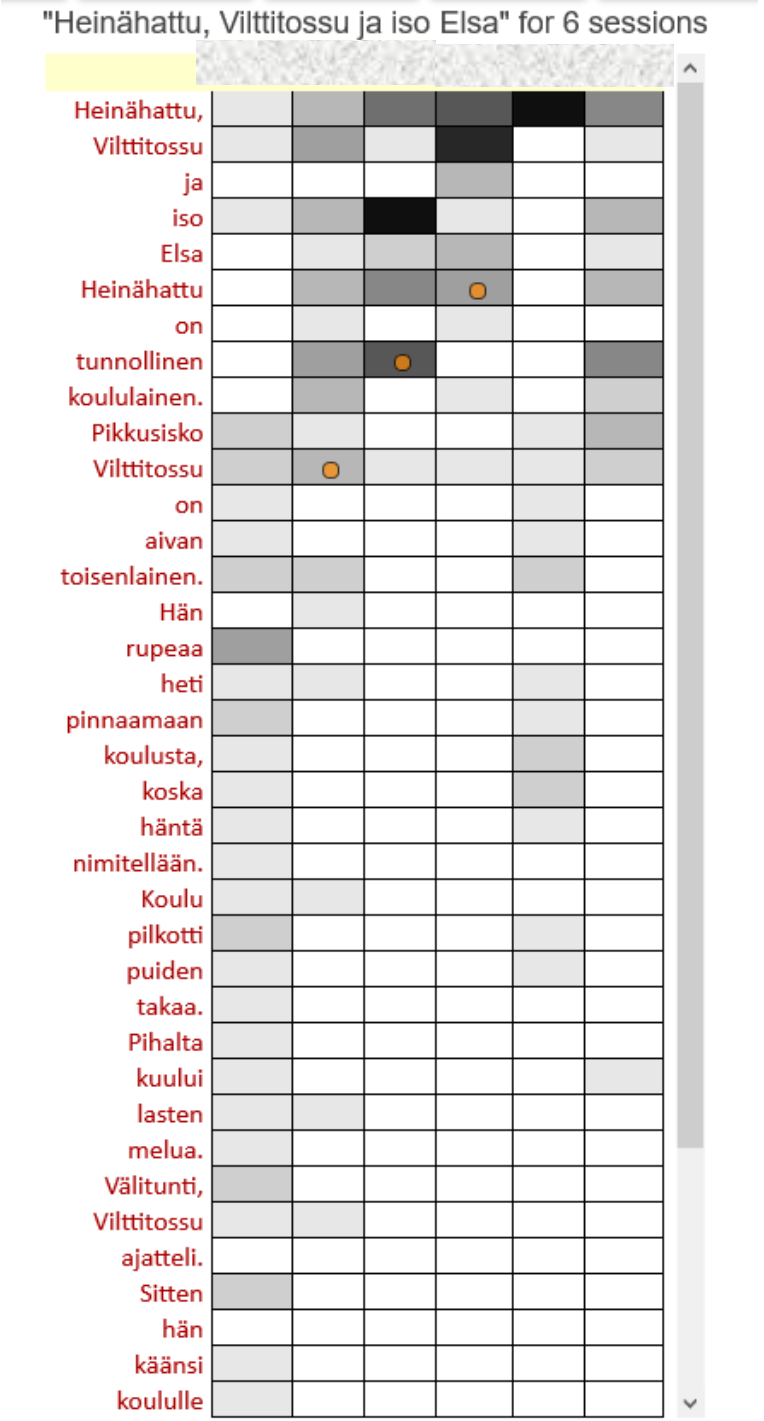
Word replay tool

- the teacher can select any group of children and watch the replay of the way in which each read the text
- here 6 children have been selected, shown in columns



Verifying effectiveness of assistance

- after each session, the children who took part were asked to look through the text they had just read (on paper) and underline the words they thought were difficult to read
- they were asked if they noticed the syllabification and whether or not it was helpful (as well as other questions)

Summary of collected data

	Number students	Mean Fixation duration	Mean Number syllabifications	Was intervention TIMELY?	Was intervention HELPFUL?
2nd Graders	18	**723** (ms)	**10.9** (13 students) 0 (5 students)	6 - yes 6 - no	1 - yes 8 - somewhat 3 - no
3rd Graders	22	**580** (ms)	**5.1** (20 students) 0 (2 students)	11 - yes 2 -sometimes 6 - no	8 - yes 4 - somewhat 5 - no

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Private and Shared Gaze: Enablers, Applications, Experiences (GaSP)

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Sanoma Pro, Helsinki

Thanks for your attention!