eFiL project
e-Feedback for interactive Lecture

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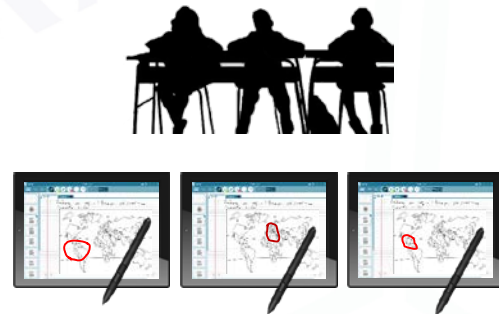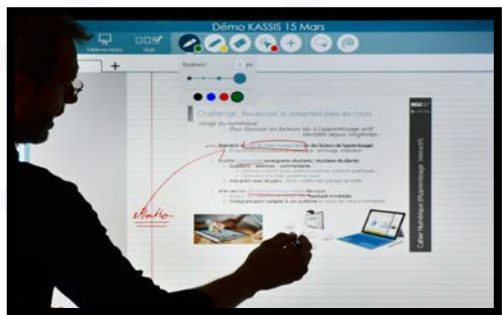## 2-year CominLabs education Project (2017-2019)

Context

The KASSIS solution for e-education

- *a new interactive digital notebook (INSA - IntuiDoc team of IRISA laboratory)*

To encourage active learning *in higher education* by

- *handwriting on tablets / student-teacher interactions / student collaboration/ immediate feedback generation*

The teacher can:
- Annotate the slides
- Compose graphic quizzes
- Propose virtual whiteboard for collaborative drawing
- Provide a collective feedback using the heatmap or graphic clustering

The students can:
- Annotate their numerical support
- Answer by drawing/handwriting using pen-based tablets
- Collaborate on shared virtual whiteboard

Goals

Three main objectives:

1. to **improve KASSIS** by a **User-Centered Design** for a better **usability** (LP3C, IRISA-IntuiDoc),

2. to examine the uses and impact of KASSIS on active pedagogy in higher education (LP3C):
   · *new types of '**graphic quizzes**' ,*
   · *new **collective feedback** (visualization by heatmap and clusters of drawings);*
   · *innovative **collaborative** whiteboards,*

3. to enrich the solution with **student and teacher activity tracking (log)** for designing **dashboards** for the teacher (LS2N + LP3C).

Objective 1: Consolidate and improve the KASSIS solution

KASSIS: Consolidate and improve the KASSIS solution

User-Centered Design
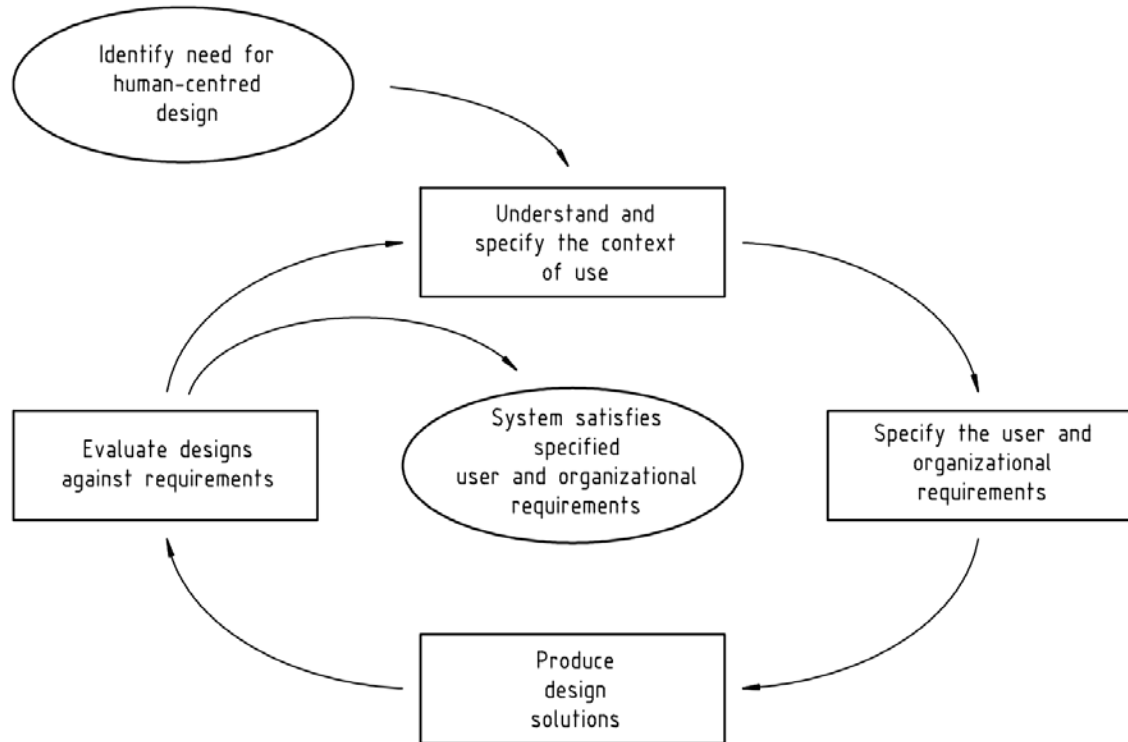
10 studies involved more than **1,181 students** and 14 different teachers

2 new original functionalities of Kassis were designed for automatic visual feedback generation: **interactive heatmap and cluster map.**

2 dashboards for the teachers were designed using activity tracking

Main information about studies realized in the project

10 studies involved more than 1,158 students and 14 different teachers

WP	Study	Objective	Nber of students	Course type	Location	Nber of teachers
1	1	Needs analysis for Kassis	323	N/A	UR2, INSA, Polytech	6
	2	Evaluate note-taking efficiency	81	User experience	UR2	1
	3	Evaluate Kassis whiteboard for collaborative drawing	76	Tornado formation	UR2	1
	4	Evaluate Kassis whiteboard for collaborative drawing	72	Anatomy for physiotherapy	IFPEK Rennes	1
2	5a	Evaluate the effect of regular quizzes	42	User experience	UR2	1
	5b	Evaluate the effect of regular quizzes and the amount of note-taking (in progress)	67	User experience	INSA UR2	1
3	6	Evaluate the importance of teacher guidance for interpreting collective feedback	70	Master's students in social and organizational psychology	UR2	1
4	7	Needs analysis for the dashboard	-	N/A	UR2, INSA, Polytech	13
	8	Comparison between interactive and traditional teaching	385	Sociometry method in social psychology	UR2	6
	9	Collection of various traces to test and improve the dashboard	9	User experience	UR2	1
4	10	Evaluate Kassis and the dashboards in a classroom setting	33	Courses and supervised work	Polytech	1
	Total		**1,158**			**14**

Improving KASSIS learning environment

Improvements: going one step further than traditional QCM quizzes

– new 'graphic quizzes' : Questions & Answers can be graphic traces

New features

1. Real-time graphic quizzes generation

2. Collection of the graphic answers
   Real-time automatic analysis graphic traces

Heat Map

3. **Automatic** generation of the **interactive feedback**
   from the collection of the graphic answer → 2 proposals

Graphic clustering

· **Heat map** when the students must
  highlight an element of a displayed support

· **Cluster map** when the students have to *compose*
  open graphic quiz

2 new original functionalities were designed
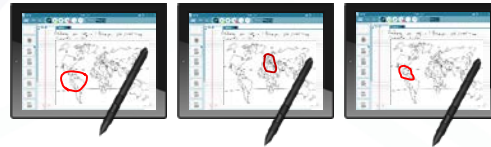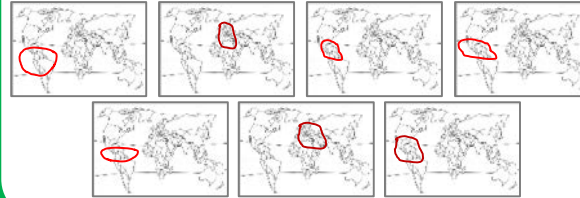
Improving KASSIS learning environment

1st New feature: *Automatic synthesis of the collected graphic answers using an interactive saliency map (Heatmap)*

1. Real-time graphic quizzes generation

2. Automatic Analysis of the collected graphic answers

3. Generation of adaptive feedback: HEATMAP

The teacher asks each student to: **Highlight the answer** on the shared reference document

The students **answer by drawing** using pen-based tablets

The teacher provides a **collective feedback** using the heatmap

Improving KASSIS learning environment

2nd New feature: Cluster Map

- Automatic analysis of student answers to generate interactive map of clusters for the collective feedback
- Open question : Answers can be any kind of drawings (mathematical formula, sketches, symbols, …)

1. Real-time graphic quizzes generation

2. Automatic Analysis of the collected graphic answers

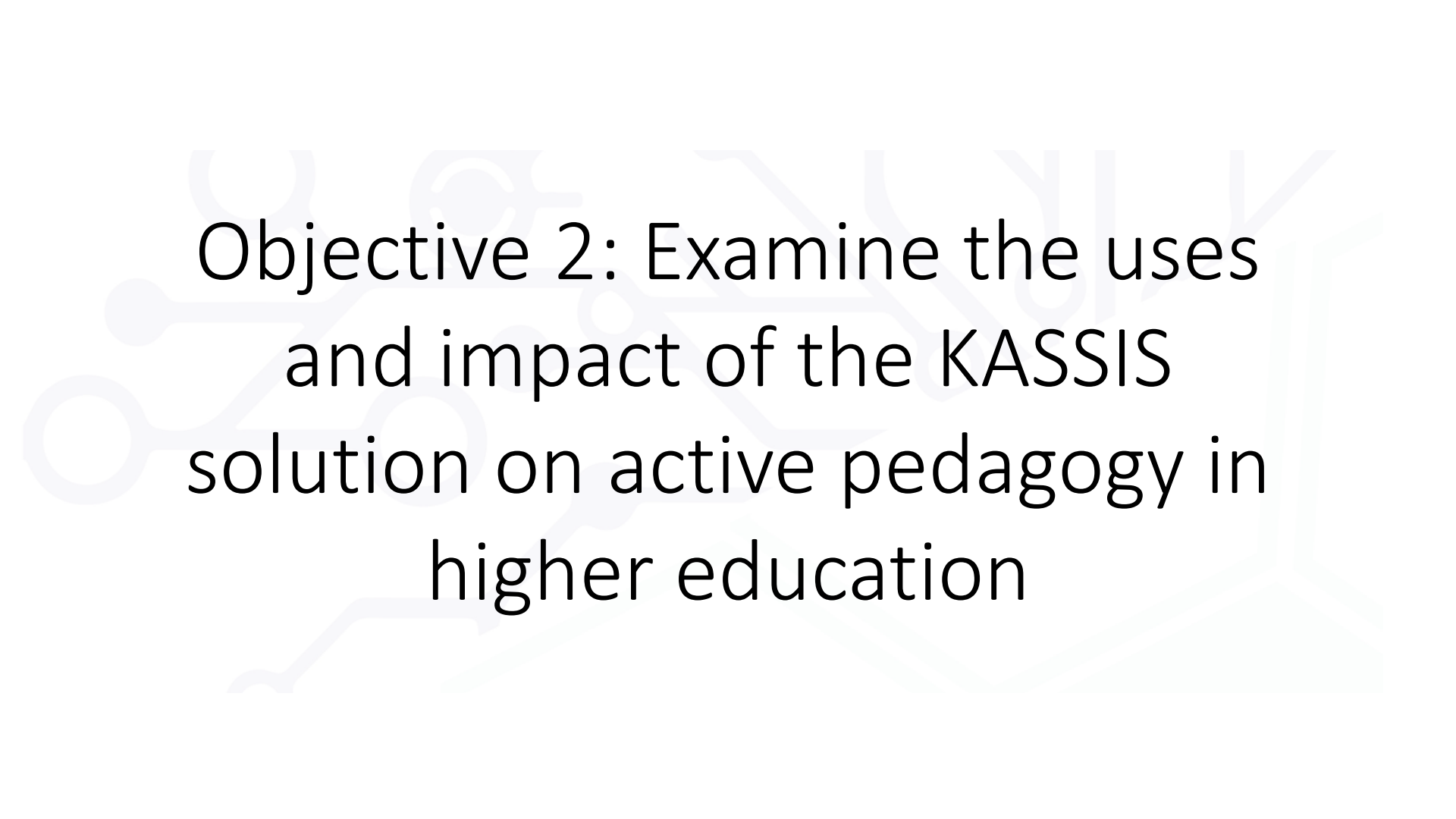Features extraction & selection

Clustering (FUZZY C-Means)

3. Generation of adaptive feedback: GRAPHIC CLUSTERS

The teacher composes an **open graphic quiz**

The **students answer** by any kind of drawings using pen-based tablets

The teacher provides a **collective feedback** using the interactive map of **graphic clusters**

Objective 2: Examine the uses and impact of the KASSIS solution on active pedagogy in higher education

Main research findings:

the uses and impact of the KASSIS solution on active pedagogy

- Even if note taking was **faster with a keyboard**, followed by paper and pen-based tablet:
  ➔ **using a tablet with a pen** is particularly relevant for disciplines in which sketches or formulae are frequently used (studies 1 and 2).

- **A very high level of interest** for KASSIS **collaborative drawing** activity was demonstrated among both teachers and learners **in medical education**
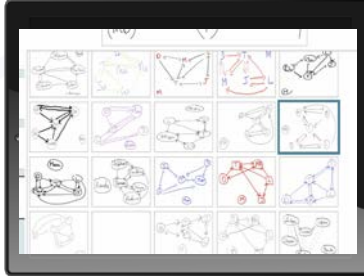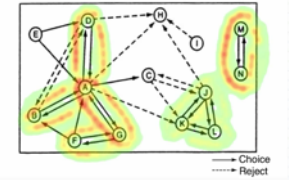 ➔ this activity needs to be scripted to be efficient (studies 3 and 4)

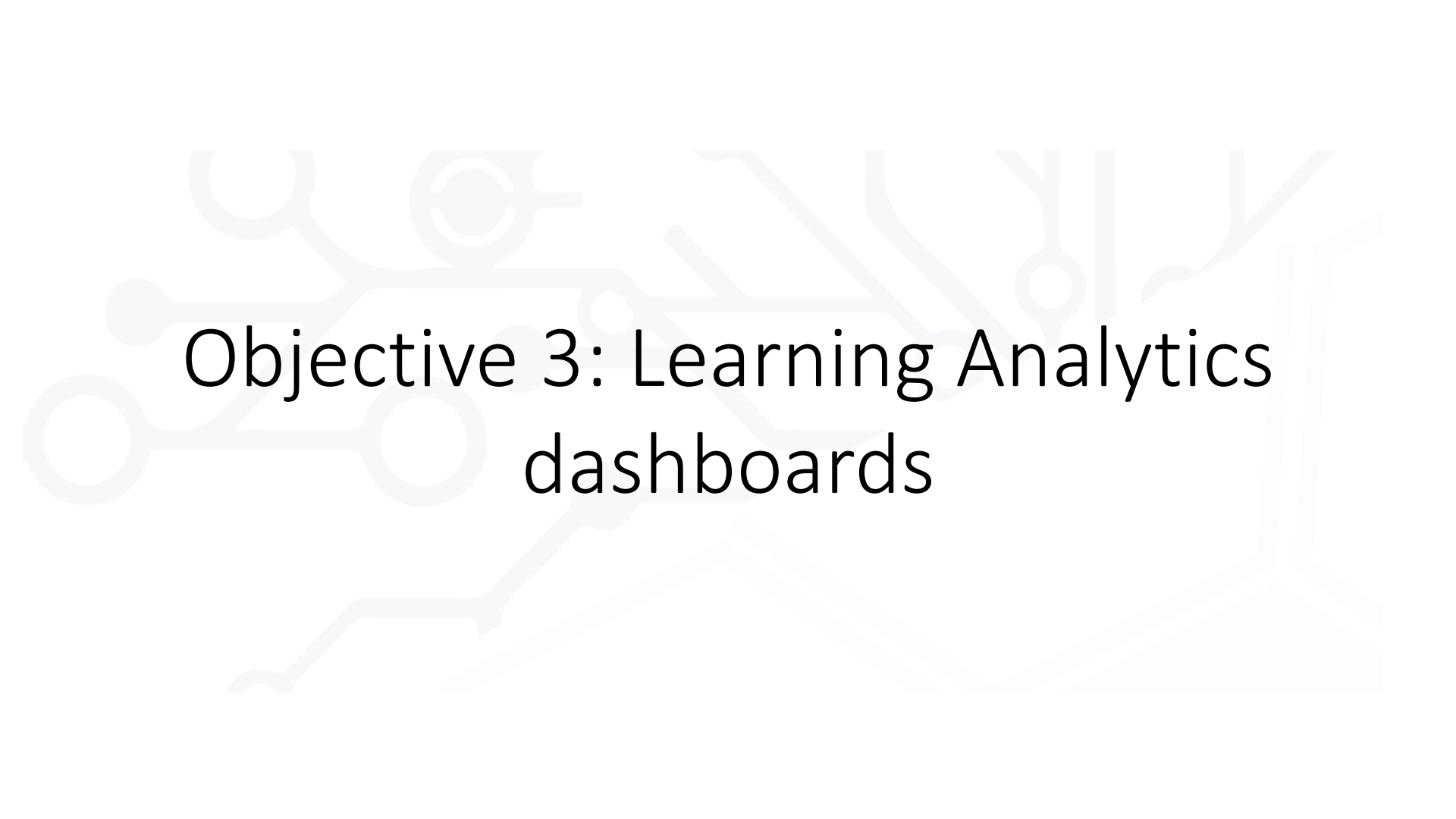| WP	Study	Objective	Nber of students	Course type	Location	Nber of teachers
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Main research findings:
the uses and impact of the KASSIS solution on active pedagogy

Circle dyad(s) on the sociogram

- **Regular quizzes** using KASSIS during the lecture improved learning outcomes more **than** quizzes administered **at the end** of the lecture (studies 5a and 5b).

- **Peer Instruction** may be extended to **graphic quizzes** (instead of multiple-choice questions), and a **collective feedback** to the whole class can be given in a **heatmap format** (instead of bar charts) with positive effects on learning outcomes **when the teacher guided students** about how to use the heatmap (study 6).

- Students using the KASSIS solution (**graphic quizzes**) perceived more satisfaction, interest in the lesson and understanding of the concepts than those in traditional teaching (quizzes on slides), but no difference was observed on academic performance (study 8).

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Objective 3: Learning Analytics dashboards

Objective 3: Traces for visualization and dashboards

Goal : to capture student and teacher activities(log),
to design 2 types of dashboards:

1. Real-time dashboard for the teacher
   ➤ *for in-class monitoring*

2. Retrospective dashboard for the teacher
   post-class for more in-depth analysis of the session
   ➤ after a lecture - provide self-awareness for the teacher.
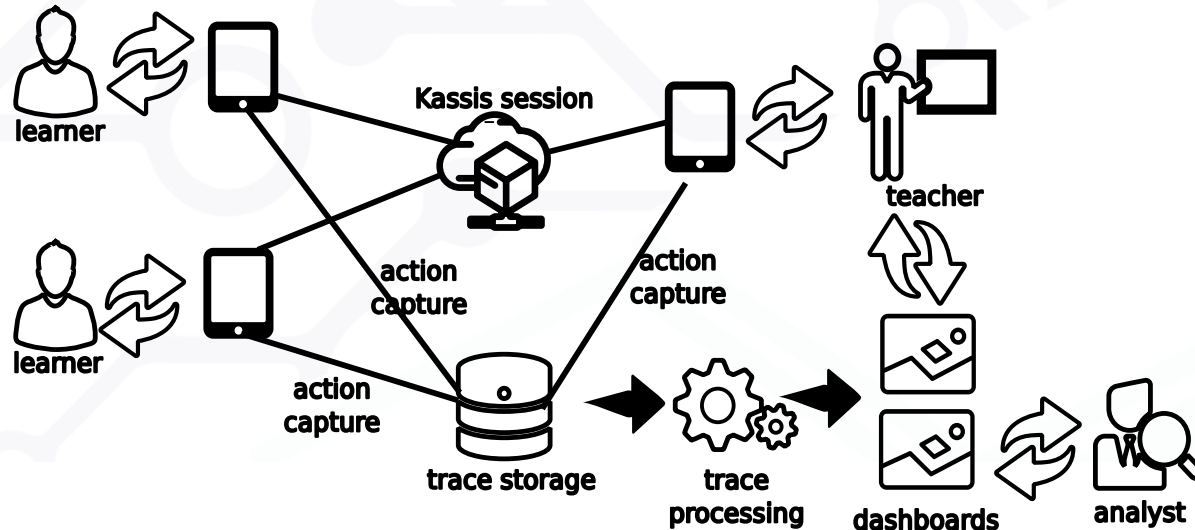   (student attention, student activity, too much time spent on a slide...)

Objective 3 - Trace collection / principle

Application instrumentation (Irisa)

Storage in a dedicated server distinct from the application server (LS2N)

User anonymization done at archival stage
- Student names may be useful for the teacher during the lecture

Objective 3 - Real-time Dashboard

Visualization of synthetic information about current class (with smartphone)

- number of connected students
- position of students wrt. teacher position in the course
- last quiz information

Objective 3 - Retrospective dashboard

– Targeted at teachers, for a-posteriori analysis of one's session (Various use cases)
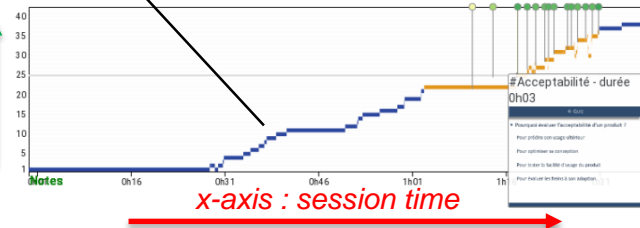

Unfolding graph
Session progression, temporality

Note-taking graph
Student activity
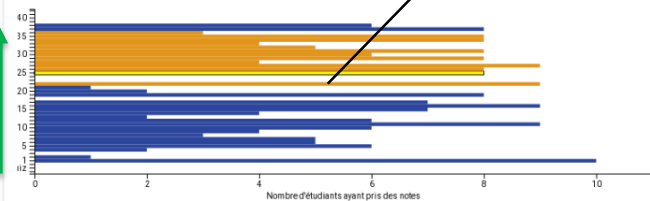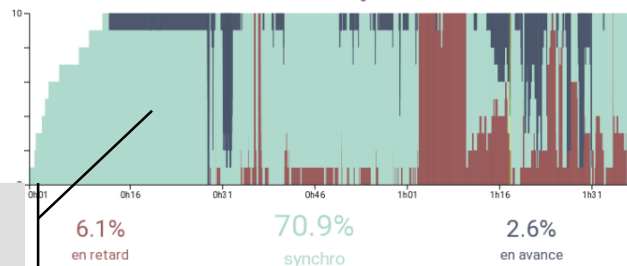
Synchronization graph
Student attention
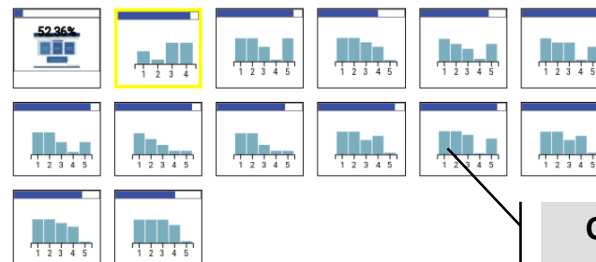
Quiz graph
Results overview

Conclusion

Main achievements of the eFiL two-year education project

- Consolidation and improvement of the KASSIS solution:

  ➢ **HeatMap and Cluster Map** for collective feedback using automatic graphic trace analysis

- Large end-user involvement

  ➢ more than **1000 students**, **10 studies**, in various pedagogical context

- Enrichment of KASSIS with Learning Analytics

  ➢ trace collection and visualization **dashboards**

- Publications have to be consolidated *(only a 2 year project consisting of 80% engineering)*

  - *4 national publications accepted*

  - *1 international publication submitted and others are in progress*

Perspectives

To continue the Multidisciplinary Researches in AI for Education

- **Pedagogy domain** : study the effects of guided drawing on learning

    Especially in disciplines who have an intensive use of sketches
    - *Science, Technology, Engineering and Mathematics (STEM)*
    - *Medical disciplines (e.g. anatomy courses)*

- **Pattern recognition (AI) domain**
    - *To analyze and recognize semi-structured handwriting sketches
    as anatomy sketches, geography, biology*

- **Learning Analytics domain**
    - *Pursuing trace collection to enable analytics mining, and research in visualization*
    - *Trace mining to identify specific behaviours/profiles*