



IMT Atlantique  
Bretagne-Pays de la Loire  
École Mines-Télécom



# Generating LADs that make sense

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# Roadmap

- 1** Context & Research questions
- 2** Theoretical framework
- 3** LADStudio
- 4** Evaluation study
- 5** Conclusion

# Why Learning Analytics Dashboards (LADs) Design Matters

- LADs : visualize educational data resulting from LA process
- Well-designed LADs: effective to **awareness & decision-making**
  - sustain the learning process & improve its outcomes
- ...but hard to design → **Limited LAD adoption**
  - little or no **stakeholder involvement** in the design process
    - inadequate addressing of their needs and expectations
    - insufficient support for their abilities e.g., visual literacy
  - poor understanding of the associated decision-making process: how the **sensemaking with LADs** occurs

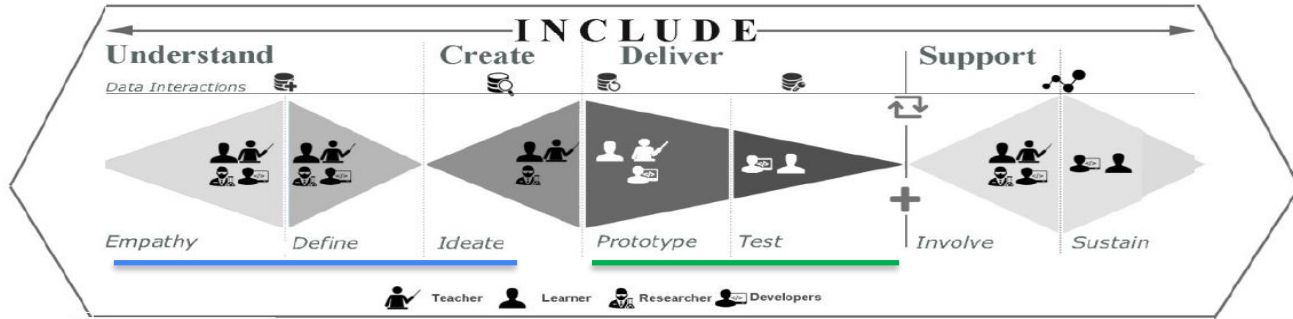
Our aim : “A design methodology that addresses these factors for effective LADs”

# Research project



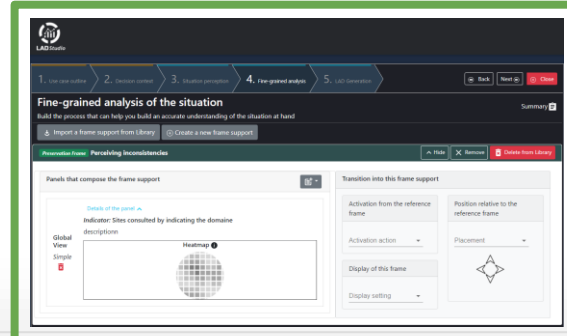
Context of Use  
Interactions and visualization domain

**Guiding Design  
Design Space  
DEFLAD**



(Prieto et al., 2018)

**Ideation:  
Codesign toolkit  
PaDLAD**

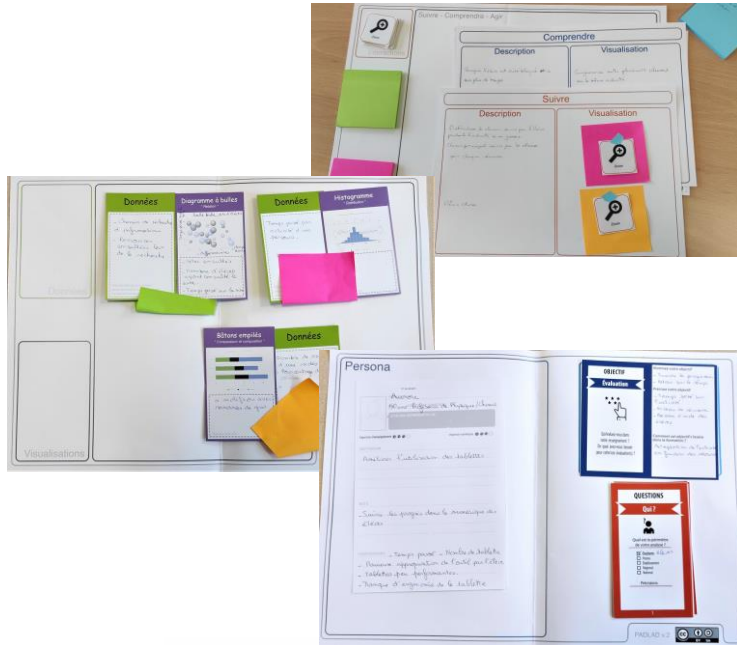


**Prototyping:  
Generating LADs  
that make sense**

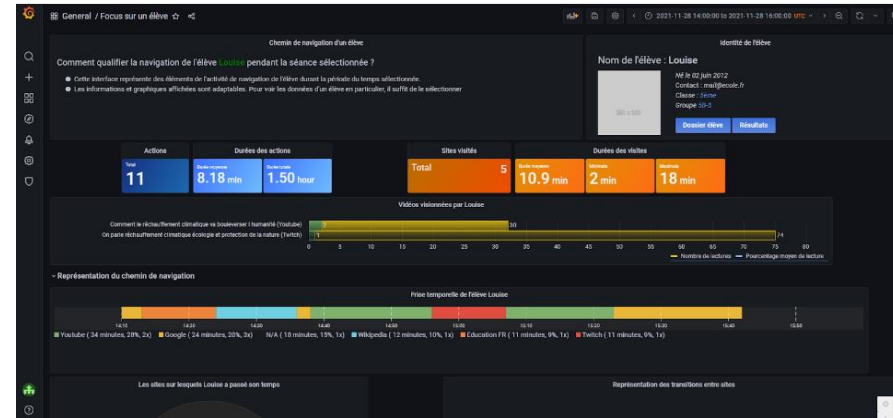
**LADStudio**

# Current stage, in other words

From this:



To this:





# Research Questions

**RQ1** How can the decision-making process be reflected on a LAD?

**RQ2** How to support designers in translating design specifications into LADs, with explicit support for the decision-making process?

# Making sense of LAD sensemaking

RQ1

How can the decision-making process be reflected on a LAD?

## “Integrate the sensemaking dimension in LAD design”

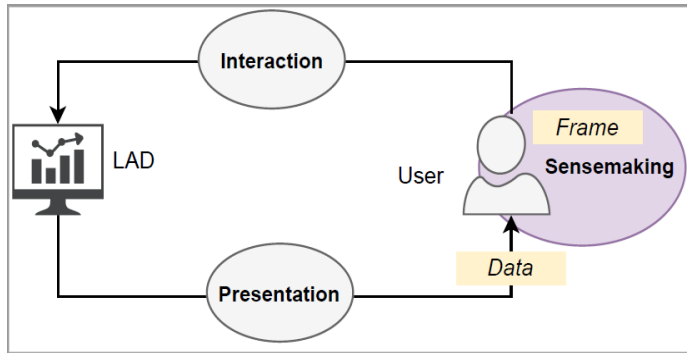
- Sensemaking = process of creating meaning from complex data
- SM with LADs = process of interpreting data presented on the LAD and using it to inform and support decision-making

# Making sense of LAD sensemaking

RQ1

How can the decision-making process be reflected on a LAD?

## “Interaction-Sensemaking Loop”



Distributed cognition theory (Hutchins 1995)

- Sensemaking develops through perception and interaction

Data/Frame theory of SM (Klein 2006)

- LAD displays = Data
- Gained insight = frame

**LAD design:** adequate support needed for accurate frame construction (e.g., effective interaction and appropriate representations)



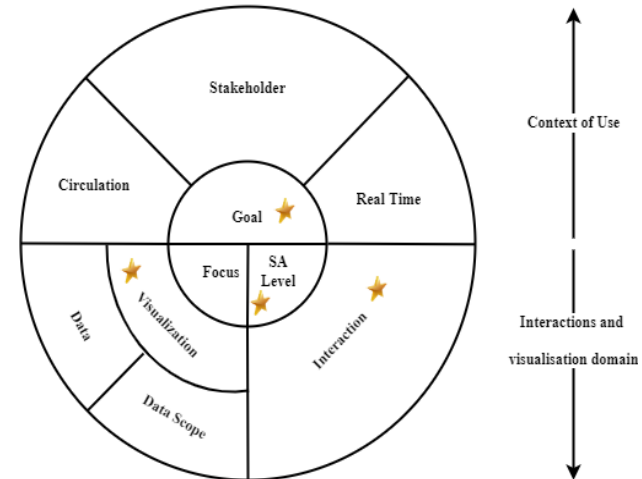
# Making sense of LAD sensemaking

RQ1

How can the decision-making process be reflected on a LAD?

DEFLAD : LAD Design Framework, defining a refined design space

- Context of use
  - LAD goal, focus and targeted SA level
  - Stakeholders, timing and info circulation
- Interaction & visualization
  - Data & representation
  - Types of Interactions
- Explicit SM features at different levels (★)



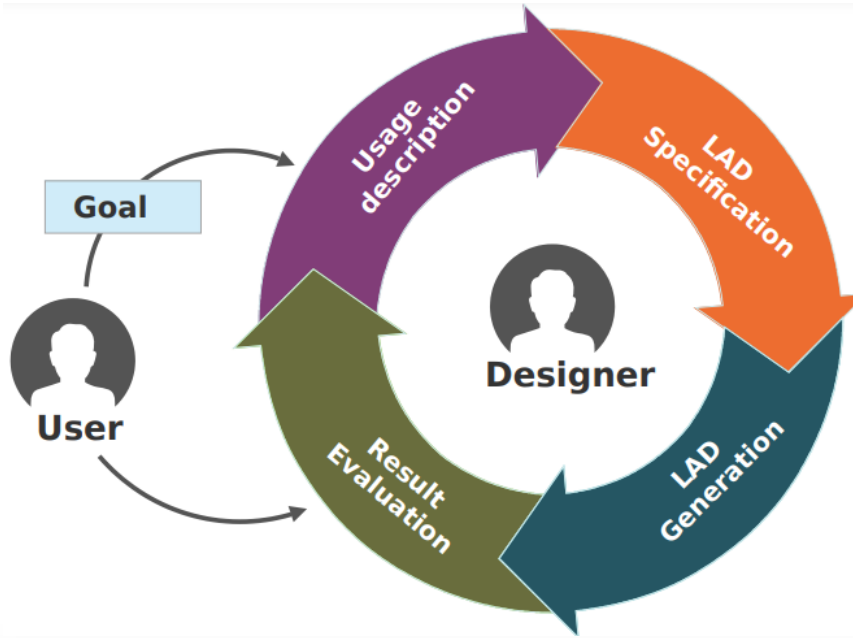
## A methodology to combine participatory design & generative design

- Participatory design
  - high levels of stakeholder involvement
  - stakeholders' needs, requirements and abilities
- Generative design
  - rapidly generate prototypes compliant with stakeholders' reqs and designer's specs
  - leveraging the computational power and efficiency

# Generative CoDesign Methodology

RQ2

Supporting designers in prototyping LADs with explicit SM processes?



## Generative codesign methodology





- Clear and structured approach
- Encourage stakeholder involvement
- Comply with end-user needs
- Rapid prototyping

# LADStudio, a tool for generating codesigned LADs

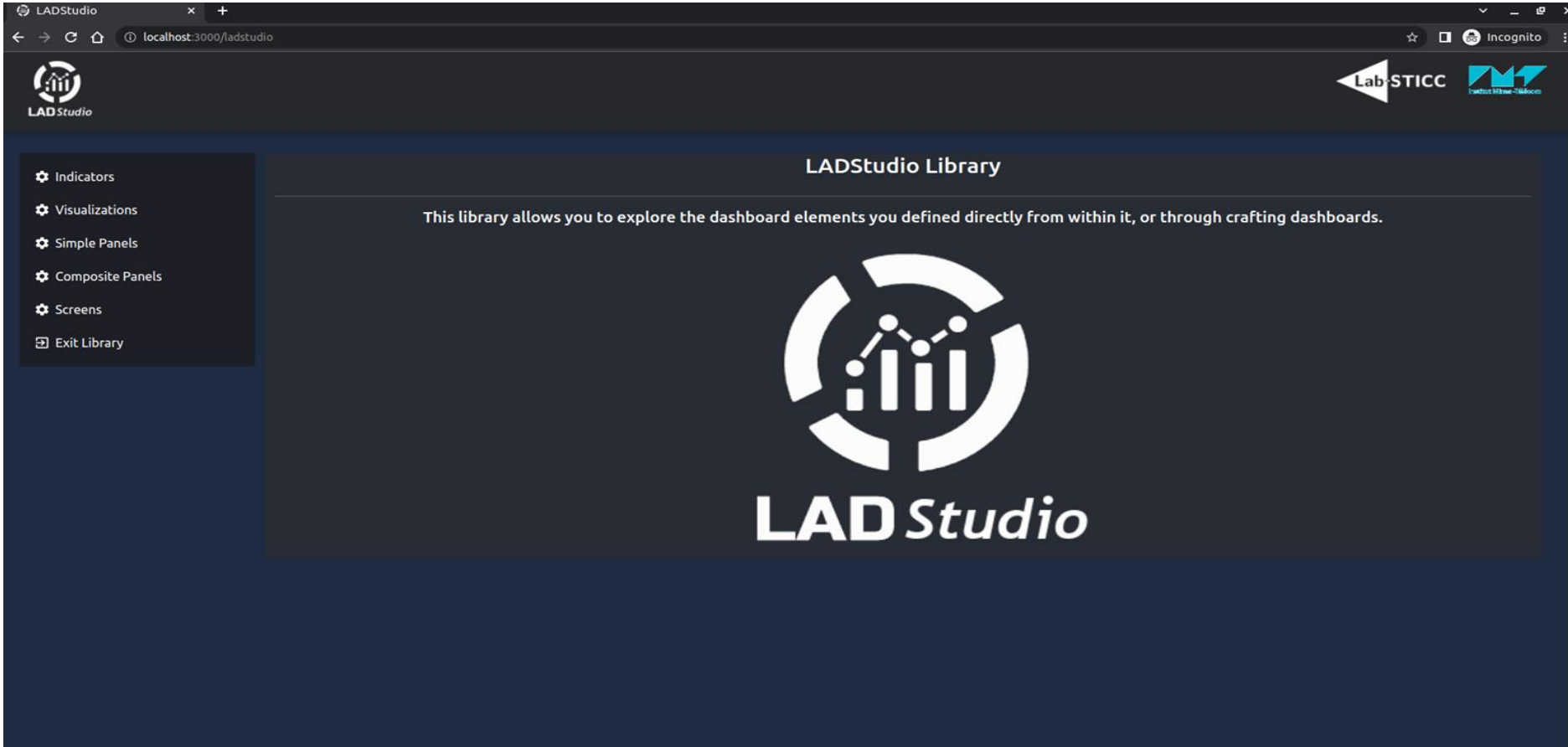
## 4 modules

1. Library of components
2. Specification module
3. Generation module
4. Grafana instance

The screenshot shows the LADStudio web application interface. At the top, there is a browser window with the URL 'localhost:3002/ladstudio'. The application header includes the LADStudio logo and the Lab-STICC logo. Below the header, a green bar indicates the current workspace is 'AT41 Projet'. A central panel contains four main modules, each with an icon and a description:

-  | Manage the Library of the Workspace
-  | Craft a new LAD Specification
-  | Edit an existing LAD Specification
-  | Grafana Local Instance

# LADStudio : library of components



The screenshot shows a web browser window displaying the LADStudio Library. The browser's address bar shows the URL `localhost:3000/ladstudio`. The page features a dark blue background with a white sidebar on the left containing a menu with the following items: Indicators, Visualizations, Simple Panels, Composite Panels, Screens, and Exit Library. The main content area is titled "LADStudio Library" and contains the text: "This library allows you to explore the dashboard elements you defined directly from within it, or through crafting dashboards." Below this text is a large white logo consisting of a circular graphic with a bar chart and a network diagram inside, and the text "LADStudio" underneath. In the top right corner of the browser window, there are logos for "Lab-STICC" and "Institut Mines-Télécom".

LADStudio

Indicators

Visualizations

Simple Panels

Composite Panels

Screens

Exit Library

LADStudio Library

This library allows you to explore the dashboard elements you defined directly from within it, or through crafting dashboards.

LADStudio

Lab-STICC

Institut Mines-Télécom

# LADStudio : library of components

The screenshot displays the LADStudio web application interface. On the left, a navigation menu lists the following components:

- Indicators
- Visualizations
- Simple Panels
- Composite Panels
- Screens
- Exit Library
























The main content area features a UML class diagram illustrating the relationships between the components:

- Panel** is associated with **Visualization** (indicated by a solid line with a filled diamond at the Panel end).
- Panel** is associated with **View** (indicated by a solid line with an open diamond at the Panel end).
- View** is associated with **Dashboard** (indicated by a solid line with an open diamond at the View end).
- View** is a generalization of **Monitoring View**, **Comprehension View**, and **Projection View** (indicated by solid lines with hollow triangle heads pointing to View).
- Visualization** is associated with **Indicator** (indicated by a dashed line with an open arrowhead pointing to Indicator).

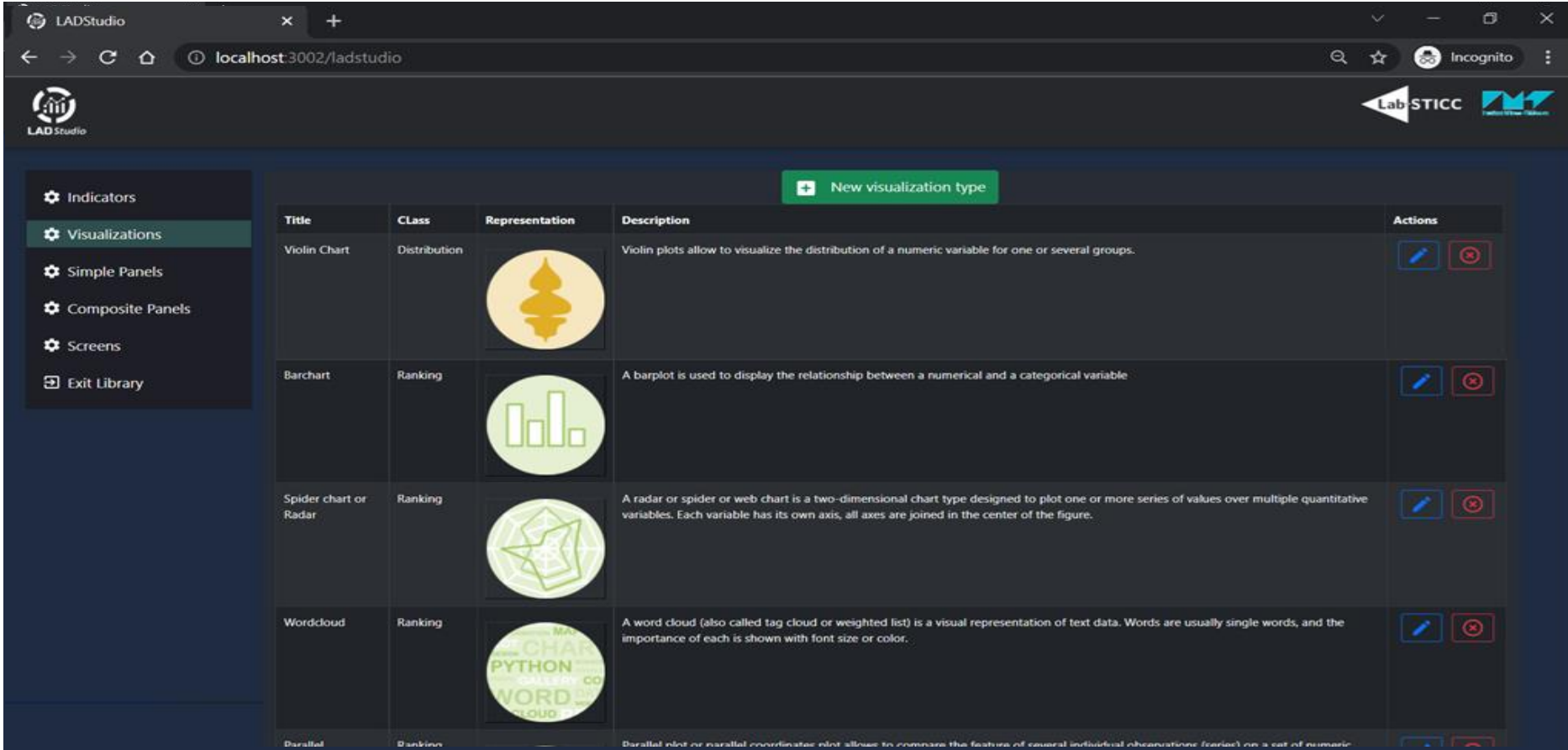
Logos for Lab-STICC and Institut Mines-Télécom are visible in the top right corner of the interface.

# LADStudio : library of components















The screenshot shows the LADStudio web application interface. The browser address bar displays 'localhost:3002/ladstudio'. The application has a dark theme and a sidebar on the left with navigation options: Indicators (selected), Visualizations, Simple Panels, Composite Panels, Screens, and Exit Library. The main content area features a 'New indicator type' button and a table of existing indicators.

Name	Class	Description	Actions
Sites consulted by indicating the domaine	Monitoring the use of media and tools	descriptionn	 
Time spent on a site	Monitoring the use of media and tools		 
Total time spent on the sites	Monitoring the use of media and tools		 
Percentage of site consultation in time	Monitoring the use of media and tools		 
Used applications	Monitoring the use of media and tools		 
Sites consulted by indicating the domaine	Monitoring the use of media and tools		 
Time spent on a site	Monitoring the use of media and tools		 
Total time spent on the sites	Monitoring the use of media and tools		 
Percentage of site consultation in time	Monitoring the use of media and tools		 
Used applications	Monitoring the use of media and tools		 
Time spent on an application	Monitoring the use of media and tools		 
Percentage of accessed applications in time by application	Monitoring the use of media and tools		 

# LADStudio : library of components















The screenshot displays the LADStudio web application interface. The browser address bar shows the URL `localhost:3002/ladstudio`. The application header includes the LADStudio logo and the Lab STICC logo. A sidebar on the left contains navigation options: Indicators, Visualizations (selected), Simple Panels, Composite Panels, Screens, and Exit Library. A central table lists various visualization types, each with a representative icon, a class name, a description, and action buttons (edit and delete).

Title	Class	Representation	Description	Actions
Violin Chart	Distribution		Violin plots allow to visualize the distribution of a numeric variable for one or several groups.	 
Barchart	Ranking		A barplot is used to display the relationship between a numerical and a categorical variable	 
Spider chart or Radar	Ranking		A radar or spider or web chart is a two-dimensional chart type designed to plot one or more series of values over multiple quantitative variables. Each variable has its own axis, all axes are joined in the center of the figure.	 
Wordcloud	Ranking		A word cloud (also called tag cloud or weighted list) is a visual representation of text data. Words are usually single words, and the importance of each is shown with font size or color.	 
Parallel	Ranking	—	Parallel plot or parallel coordinates plot allows to compare the features of several individual observations (series) on a set of numeric	 



# LADStudio : library of components

The screenshot displays the LADStudio web application interface. The browser address bar shows the URL `localhost:3002/ladstudio`. The application header includes the LADStudio logo on the left and the Lab STICC logo on the right. A left sidebar menu contains the following items: Indicators, Visualizations, Simple Panels (highlighted), Composite Panels, Screens, and Exit Library. The main content area features a green button labeled "New simple panel" and a table listing various components.

Title	Indicator	Representation	Description	Actions
New	Total time spent on the sites	Parallel Coordinates chart 	Ce panel permet de voir ceci avec cela.	 
A Panel	Total time spent on the sites	Parallel Coordinates chart 	Description	 
Testing	Used applications	Lollipop chart 	Description	 
Comparing	Number of sites consulted	Bar chart 	Description	 

# LADStudio : LAD specification & generation

The screenshot shows the LADStudio web application in a browser window. The browser address bar shows 'localhost:3002/ladstudio'. The application header includes the LADStudio logo and navigation icons. A progress bar at the top indicates five steps: 1. Use case outline, 2. Dashboard Goal, 3. Monitoring & perception, 4. Analyzing & comprehension, and 5. Dashboard generation (the current step). Navigation buttons for 'Back', 'Next', and 'Close' are visible. The main content area is divided into two sections: 'Learning context' and 'Dashboard use context'. The 'Learning context' section includes a dropdown for 'Type of learning environment' (set to 'Institutional LMS'), a text input for 'Environment details' (set to 'Collège Blois'), a dropdown for 'Your role within the learning context' (set to 'Teacher - (in charge of the course)'), and a text input for 'Complementary information about your role'. The 'Dashboard use context' section includes a list of roles with checkboxes: 'Learners' (unchecked), 'Teachers' (checked), 'Managers' (unchecked), and 'Researchers' (unchecked). Below this, there are two more checkboxes: 'In real time' (unchecked) and 'Retrospectively' (checked). A 'Summary' icon is located in the top right corner of the main content area.

LADStudio

localhost:3002/ladstudio

Lab-STICC

1. Use case outline 2. Dashboard Goal 3. Monitoring & perception 4. Analyzing & comprehension 5. Dashboard generation

Back Next Close

## Learning context

Describe the learning context and your role within

Type of learning environment

Institutional LMS

Environment details

Collège Blois

Your role within the learning context

Teacher - (in charge of the course)

Complementary information about your role

Provide a short description

## Dashboard use context

Describe the context where the dashboard is meant to be used

The dashboard will be used by

- Learners
- Teachers
- Managers
- Researchers

The dashboard will be used

- In real time
- Retrospectively

Summary

# LADStudio : LAD specification & generation

The screenshot shows the LADStudio web application in a browser window. The browser address bar shows 'localhost:3002/ladstudio'. The application header includes the LADStudio logo and navigation icons. A progress bar at the top indicates five steps: 1. Use case outline, 2. Dashboard Goal (current step), 3. Monitoring & perception, 4. Analyzing & comprehension, and 5. Dashboard generation. Navigation buttons for 'Back', 'Next', and 'Close' are visible. The main content area is titled 'Main Goal of the LAD' and contains several form fields and a list of options.

**1. Use case outline** | **2. Dashboard Goal** | 3. Monitoring & perception | 4. Analyzing & comprehension | 5. Dashboard generation

Back | Next | Close

## Main Goal of the LAD

Provide a title for describing the intended goal of this LAD

Title Blois groupe 1

Type of the goal

Monitor achievement status

Provide a short description of the the use goal and the potential decision to be taken

Description

The pursued goal is based on the analysis of data that describe

- A specific student
- A class or a given groupe of learners
- All enroled learners
- Other !

The main target of the actions resulting from the use of the LAD

- Person (learner/teacher/...) - focused on the user and his profile
- Activity - centered on the use of the elements of the course
- Context - focused on the situation in which the learning/teaching occurs
- Results - focused on grades or assessments
- Content - focused on course content and resources
- Social - focused on forums and exchanges

Summary

# LADStudio : LAD specification & generation

The screenshot displays the LADStudio web application interface. At the top, the browser address bar shows 'localhost:3002/ladstudio'. The application header includes the LADStudio logo and navigation icons. A progress bar at the top indicates five steps: 1. Use case outline, 2. Dashboard Goal, 3. Monitoring & perception (current step), 4. Analyzing & comprehension, and 5. Dashboard generation. The main heading is 'Screen for monitoring and perceiving particular situations', with a sub-heading 'Build the process that can help you monitoring and perceiving any situation that you judge as important'. Below this, there are buttons for 'Import a screen from Library' and 'Create a new screen', with a warning icon and text 'This will overwrite the current screen'. The current screen is titled 'Elaboration Screen Testing New Screen 2'. The interface is divided into two main sections: 'Panels that compose the frame support' and 'Transition into this screen'. The 'Panels that compose the frame support' section shows a 'Heatmap' panel with a grid of squares and a 'Global View Simple' button. The 'Transition into this screen' section has two columns of settings: 'Activation from the reference screen' (Activation action: Click) and 'Position relative to the reference screen' (Placement: Below). A diagram shows a 'Reference Frame' (red box) and a 'New Frame' (green box) positioned below it. The 'Display of this screen' section has a 'Display setting' dropdown set to 'Overlap'.

LADStudio

localhost:3002/ladstudio

LabSTICC

1. Use case outline 2. Dashboard Goal 3. Monitoring & perception 4. Analyzing & comprehension 5. Dashboard generation

Back Next Close

Summary

## Screen for monitoring and perceiving particular situations

Build the process that can help you monitoring and perceiving any situation that you judge as important

Import a screen from Library Create a new screen ⚠ This will overwrite the current screen

Elaboration Screen Testing New Screen 2 Hide Remove Delete from Library

### Panels that compose the frame support

Details of the panel ↗

Indicator: Sites consulted by indicating the domain descriptionn

Global View Simple

Heatmap ⓘ

### Transition into this screen

Activation from the reference screen

Activation action: Click

Position relative to the reference screen

Placement: Below

Reference Frame

New Frame

Display of this screen

Display setting: Overlap

# LADStudio : LAD specification & generation

The screenshot displays the LADStudio web application interface. At the top, the browser address bar shows 'localhost:3002/ladstudio'. The application header includes the LADStudio logo and the Lab-STICC logo. A progress bar at the top indicates five steps: 1. Use case outline, 2. Dashboard Goal, 3. Monitoring & perception, 4. Analyzing & comprehension, and 5. Dashboard generation. The current step is 'Analyzing & comprehension'. Below the progress bar, the main heading is 'Fine-grained analysis of the situation', with a sub-heading 'Build the process that can help you build an accurate understanding of the situation at hand'. There are two buttons: 'Import a screen from Library' and 'Create a new screen'. A secondary bar contains 'Elaboration Screen', 'New Screen', and buttons for 'Hide', 'Remove', and 'Delete from Library'. The main content area is divided into two panels. The left panel, 'Panels that compose the frame support', shows a tree structure with 'A Panel' (Simple) and 'Elements that compose the panel'. Under 'Elements that compose the panel', there is a 'New' section with a 'Parallel Coordinates chart' indicator. The right panel, 'Transition into this screen', contains settings for 'Activation from the reference screen' (Activation action: Click), 'Position relative to the reference screen' (Placement: On the left), and 'Display of this screen' (Display setting: Replacement). A visual representation shows a green 'New Frame' and a red 'Reference Frame'.

# LADStudio : LAD specification & generation

The screenshot displays the LADStudio web application interface. At the top, the browser address bar shows `localhost:3002/ladstudio`. The application header includes the LADStudio logo and navigation icons for LabSTICC and another system. A progress bar at the top indicates five steps: 1. Use case outline, 2. Dashboard Goal, 3. Monitoring & perception, 4. Analyzing & comprehension, and 5. Dashboard generation. The current step is 5. Action buttons for 'Back', 'Generate', and 'Close' are visible. The main content area is titled 'Dashboard JSON structure' and contains a code editor with the following JSON:

```
{
  "root": {
    "annotations": {
      "list": [
        {
          "builtIn": 1,
          "datasource": "-- Grafana --",
          "enable": true,
          "hide": true,
          "iconColor": "rgba(0, 211, 255, 1)",
          "name": "Annotations & Alerts",
          "type": "dashboard"
        }
      ]
    },
    "editable": true,
    "gnetId": null,
    "graphTooltip": 0,
    "links": [],
    "panels": [
      {
        "collapsed": true,
        "datasource": null,

```

On the right side, there is a 'Summary' tab and an 'Export' dropdown menu with options for 'JSON Download' and 'Save to Grafana'. A 'Generate the dashboard' button is also present.

# LADStudio : LAD specification & generation

The screenshot displays the LADStudio web application interface. At the top, there is a navigation bar with the LADStudio logo and a breadcrumb trail: 1. Use case outline, 2. Dashboard Goal, 3. Monitoring & perception, 4. Analyzing & comprehension, and 5. Dashboard generation. The current step, 'Dashboard generation', is highlighted. To the right of the navigation bar are buttons for 'Back', 'Generate', and 'Close'. Below the navigation bar, there is a 'Summary' icon. The main content area shows the 'Dashboard JSON structure' with a 'Generate the dashboard' button and an 'Export' dropdown menu. A modal dialog titled 'Insert into a Grafana Instance' is open, displaying the following information:

Dashboard Title	Elois groupe 1
Instance URL	http://localhost
Authorization Key	eyJrIjoieMEVVZ2FwRnJicE1ZU1R4TXJBRTNYTUJMchoSc.
Status:	Ready

At the bottom of the modal dialog are 'Close' and 'Save' buttons. The background shows a JSON structure for the dashboard, including fields like 'root', 'annotations', 'panels', and 'links'.

# LADStudio : LAD specification & generation





# Qualitative evaluation study

- Evaluate usability and user experience of LADStudio
- 13 Participants: purposive sampling
  - Inclusion: experience with EdTools
  - Exclusion: unwillingness to participate
- Evaluation procedure
  - LADStudio demonstration
  - Independent experimentation
  - Collective codesign workshop
  - Questionnaire and open-ended questions
  - Duration: 2 hours

Variable	Category	n (%)
Gender	Male	8 (61.54)
	Female	5 (38.46)
Age	25–35	3 (23.08)
	36–45	7 (58.84)
	46–55	3 (23.08)
Staff	University Teacher	4 (30.77)
	Researcher	6 (46.15)
	Software developer	3 (23.08)

# Evaluation study: instruments

- Usability evaluation
  - System Usability Scale (SUS) questionnaire
  - Reliable usability measure
- User Experience (UX) evaluation
  - User Experience Questionnaire (UEQ)
  - Valid tool for UX assessment
  - 26 items, 6 scales: *attractiveness, efficiency, perspicuity, dependability, stimulation, novelty*

- 
- Q1 I think I would like to be able to use LADStudio frequently
  - Q2 I found LADStudio unnecessarily complex
  - Q3 I thought LADStudio was easy to use
  - Q4 I think that I would need support to be able to use LADStudio
  - Q5 I found the various components of LADStudio were well integrated
  - Q6 I thought there was too much inconsistency in LADStudio
  - Q7 I would imagine that most people would learn to use LADStudio fairly quickly
  - Q8 I found LADStudio very cumbersome to use
  - Q9 I felt very confident using the LADStudio tool
  - Q10 I needed to learn a lot before I could use the LADStudio tool
-

# Results: usability

SUS score: **71.15**

System usability rated as **OK**

Positive statements			Negative statements				
A	N	D	A	N	D		
Q1	9	2	2	Q2	0	1	12
Q3	10	2	1	Q4	7	3	3
Q5	11	1	1	Q6	0	0	13
Q7	2	4	7	Q8	1	0	12
Q9	10	3	0	Q10	3	6	4

A: Agree or Strongly agree; N: Neither agree nor disagree; D: Disagree or Strongly disagree

- **Highest scores**
  - Q1: ... able to use it frequently
  - Q3: ... easy to use
  - Q5: ...components well integrated
- **Lowest scores**
  - Q2: ... unnecessarily complex
  - Q4: ...need support
  - Q6: ...too much inconsistency

# Results: UX

UEQ score: **1.99**

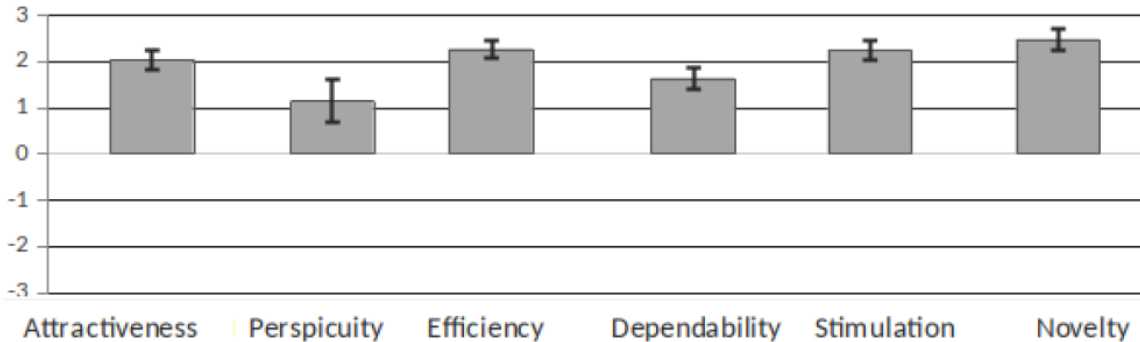
Rating : **Good!**

- **Highest score**

- novelty
- efficiency
- stimulation

**Lowest score**

- perspicuity





# Results: Participants' Feedback

- Challenging at first but effective with practice
- Capable of creating useful and well-designed LADs
- Reasoning mirroring, support and guidance, at design

## Improvement areas

- Challenging theoretical concepts
- Need design support ; lack of data/visual literacy



# Discussion

- Usability & UX: satisfactory
- Encouraging feedback
- Some limitations
  - self-selection bias
  - small sample size restricts generalizability,
  - further investigation needed for LAD quality



# Conclusion & outlook

- Efficient and involved LAD design methodology
  - participatory & generative
- LADStudio: functional prototypes from co-design specs
  - Success in innovative proposals and LAD adoption
- Next steps:
  - collect user and practitioner LAD proposals
  - address design adoption issues, and
  - share findings with the learning community.



# Thank you for your attention!

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