

# MultiModal Learning eXperiences & Learning Analytics

Annual meeting

Center for education & learning, Delft

12.12.22



Universiteit  
Leiden  
The Netherlands



Erasmus  
University  
Rotterdam



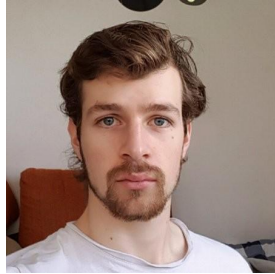
# The teaMM (*virtualisation, MLX*)



Bibeg



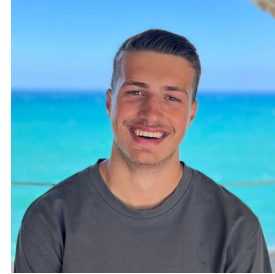
Nesse



Olivier



Jorge



Otte

# Why MultiModal

Puts **Context** into the LA

- Meaningful interpretation of the learning process
- LA on steroids

Scientist: my discoveries are useless if taken out of context



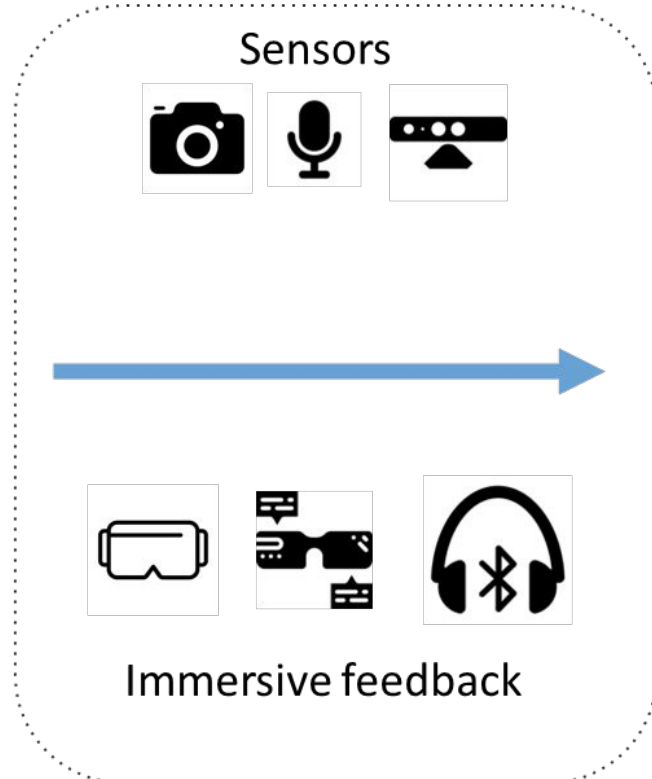
Media:

**Scientist claim their discoveries are useless**

# Beyond formal settings



Constrained learning settings



*Teaching*  
MultiModal Learning  
Analytics

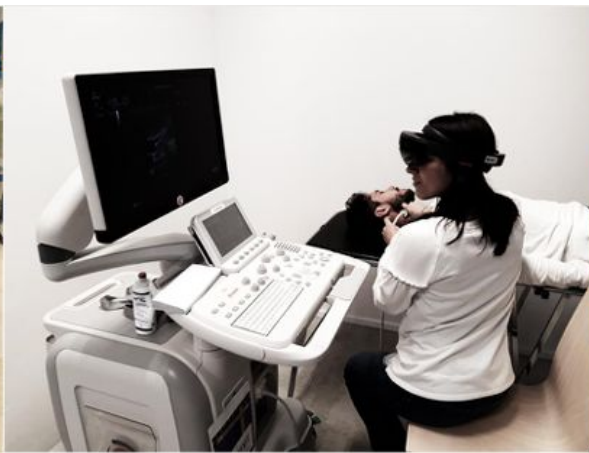


Learning analytics for teachers

# WEKIT: Wearable experiences for knowledge intensive training



Aircraft maintenance

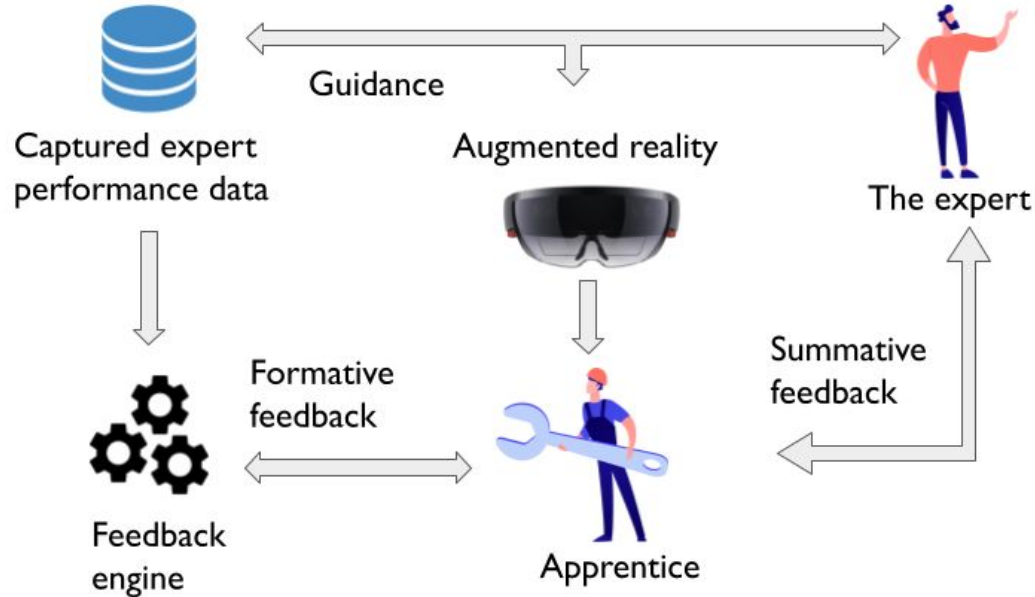


Medical ultrasound



Astronaut training

# WEKIT: Expert-based teaching methodology



# Holographic Learning ~~X~~ Teaching

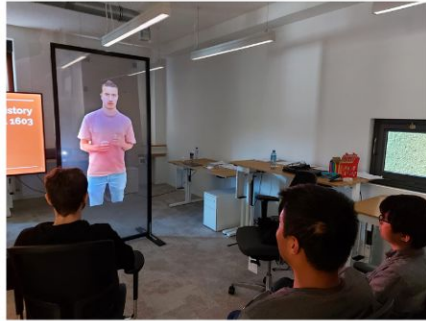
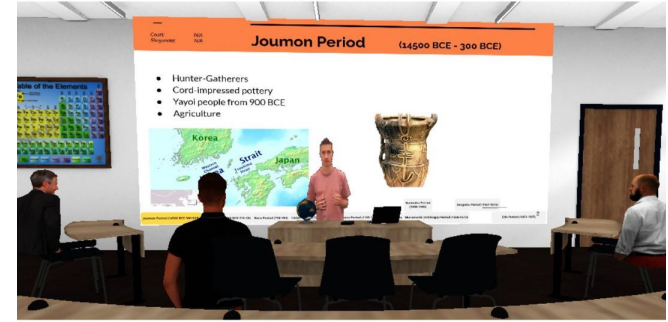
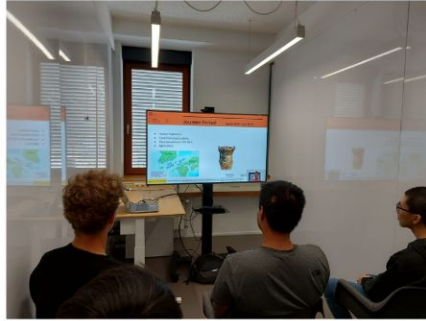
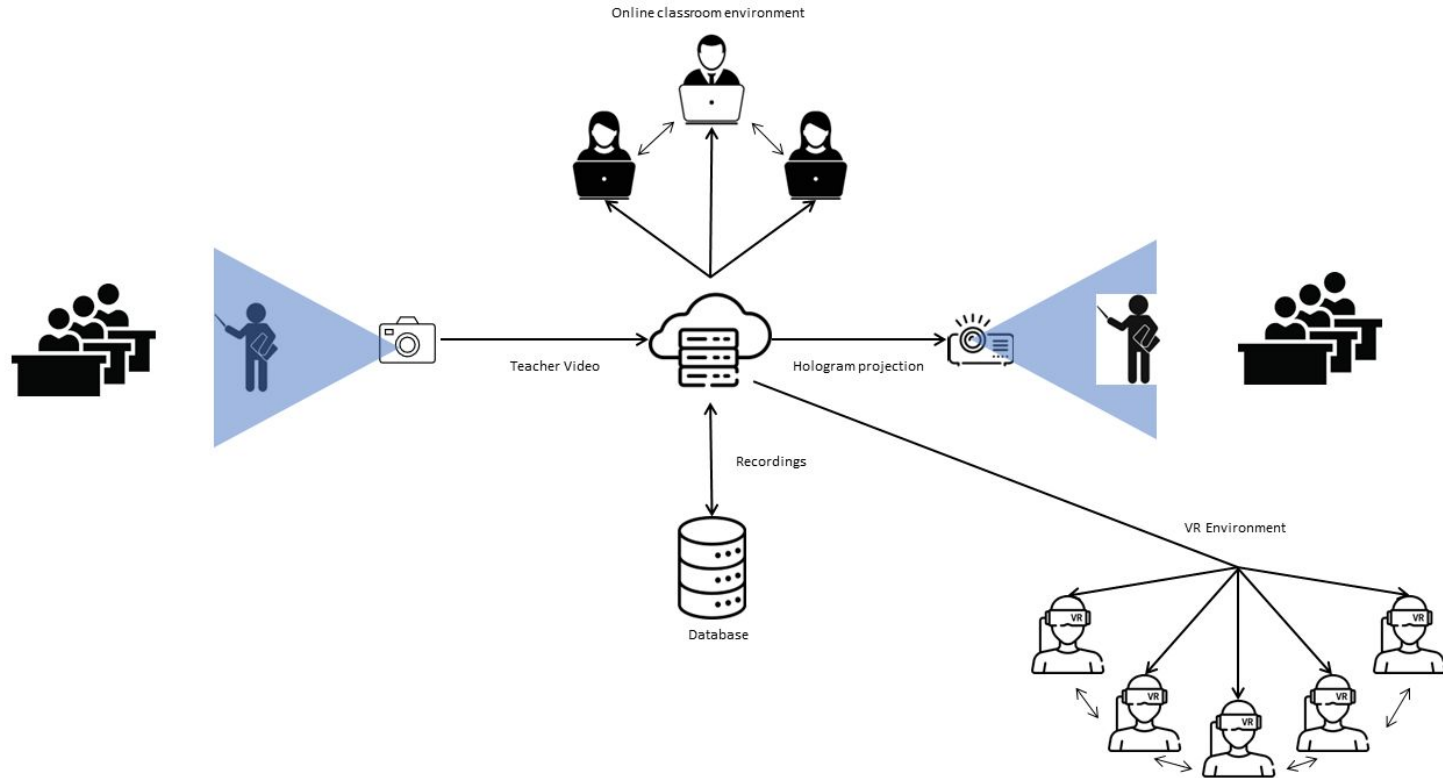


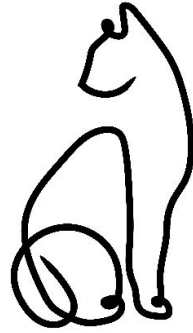
Figure 3: The setups arrangement: Zoom (top-left), robot (top-right), HoloDisplay (bottom-left), HoloVR (bottom-right).



# HoloLearn: Facilitating *sync/async* teaching



# The CaT: The Calligraphy Trainer



Login as Teacher

Login as Student

# Problem - Learning Handwriting

“More than 30% of girls and more than 50% of boys have **problems acquiring fluid and legible handwriting**” *Marquardt et al., 2016*

“**Teachers** often comment on a **lack of time** to complete the learning process” *Bonneton-Botté et al., 2021*



# Goal

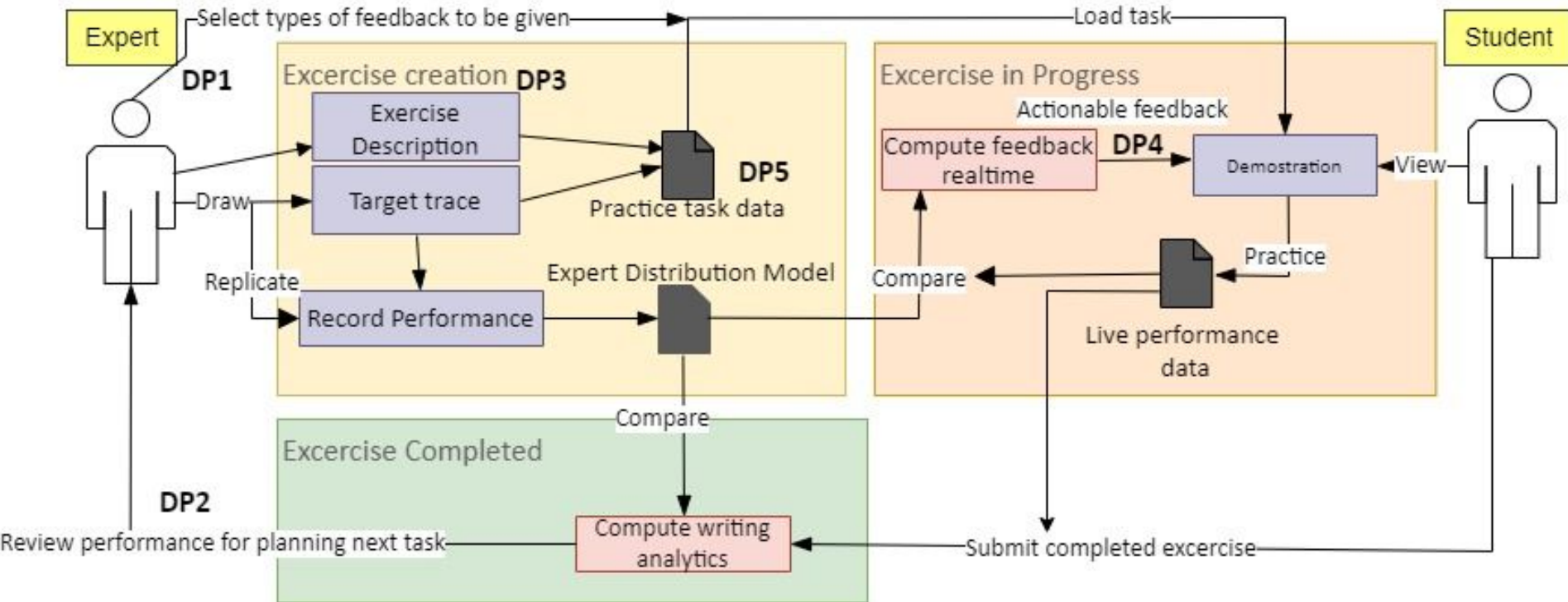
- Support teacher with close supervision of multiple students
- Enable teacher to provide highly custom and personalised learning content



# Deliberate Practice

- **DPI** The teacher must define the task concretely with a clear goal and ensure that the student understands it
- **DP2** The difficulty of the task must be barely above the students expertise level
- **DP3** The practice task must be designed and performed in accordance with individualised instruction and guidance of a teacher
- **DP4** The teacher should provide immediate informative and actionable feedback on each performance of the practice task which allows students to make appropriate adjustments to improve
- **DP5** The students are able to “repeatedly perform the same or similar tasks”

# Background - Deliberate Practice Framework



# Live Demo

# Workshop Participation Overview

1. Brief overview of the datavis tool for Calligraphy Psychomotor skill Analytics
2. Visualization **validation**:
  - Each participant is presented a visualization with several questions
    - Fill in the MCQ answers based on **ONLY the given visualization**
    - Open text field for suggestions and feedback



# Data vis VALIDATION

- Why validate?
  - Huge design space
  - Most designs ineffective
  - Teacher
- 4 nested design levels
- Focus on **idiom**
  - “How” to complete task



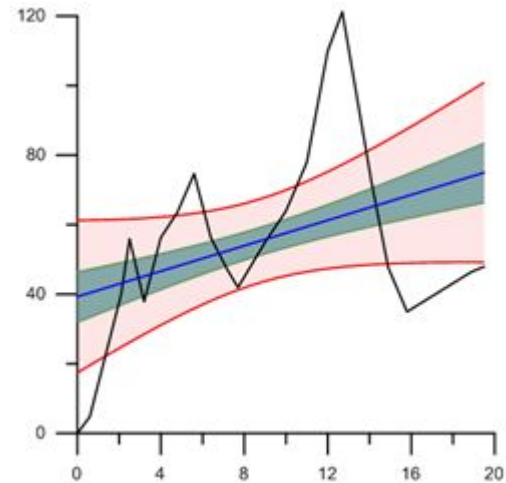
# Exercise Report Analytics - Teacher Main Tasks

- **DPI:** Task defined concretely with clear goal, ensuring the student understands it
- **DP2:** Task difficulty barely above the students expertise
  
- Teacher's two main tasks:
  - *Does the student have problems?* → Find Biggest mistakes and identify the problem
    - **DPI & DP2**
  - *What is the student's motor skill level?* → Observe student's level of control for each handwriting parameter (speed, pressure, curvature, precision)
    - **DP2**

# Exercise Report Analytics - Overview

	Big Errors	Correctness	Progress
Pressure	7	65%	None
Curvature	4	78%	Minor
Speed	21	72%	Good
Precision	2	86%	Minor
All Features	34	75%	Good

[Click For Details](#)



# Exercise Report Analytics - Top Errors

General Overview Stats

Select Features	Big Errors	Correctness	Progress
Pressure	7	65%	None
Curvature	4	78%	Minor
Speed	21	72%	Good
Precision	2	86%	Minor
All Features	34	75%	Good

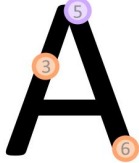
Exercise Information

Student Name: \_\_\_\_  
 Exercise Name: Capital letter "A" 1  
 Exercise Description:  
 Trace over the capital letter "A" while focussing on tracing precision and producing straight stroke sections.  
 Repetitions: 12  
 Difficulty: 2/5

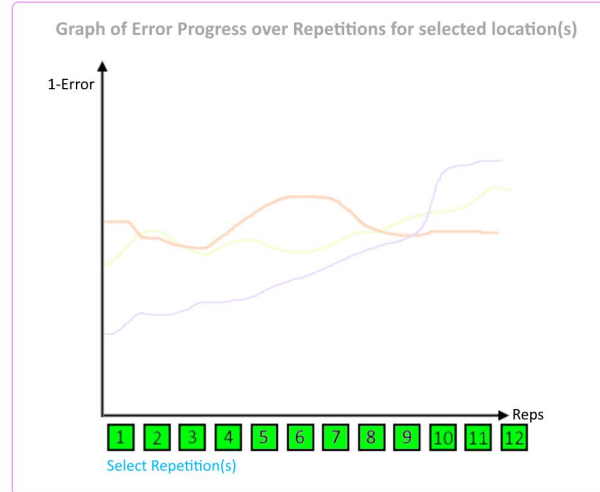
Error Location View:  
 Top Errors / Heatmap / Detail Inspector

Select Stroke(s) 1 2

Select view type  
 Top Errors  
 Heatmap



Top Errors Controls: Top 3 5 Order by   
 Biggest Individual Errors  
 Most occurring Errors  
 Least Progress Errors



# Data Scope selection - Top Level Selection

Select Feature(s)

Pressure

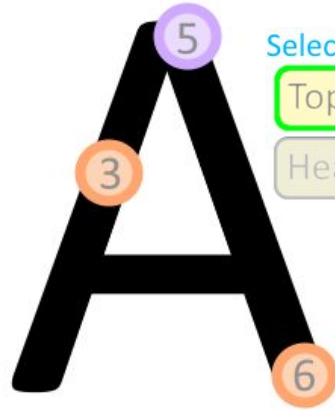
Curvature

Speed

Precision

All Features

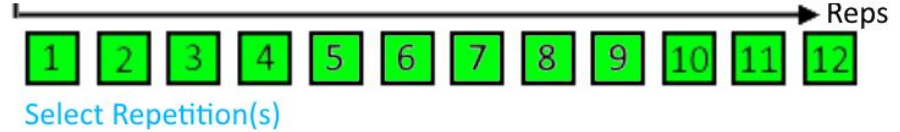
Select Stroke(s)



Select view type

Top Errors

Heatmap



Select Repetition(s)

# Exercise Report Analytics - Top Errors

General Overview Stats

Select Features	Big Errors	Correctness	Progress
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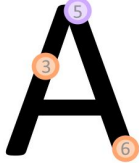
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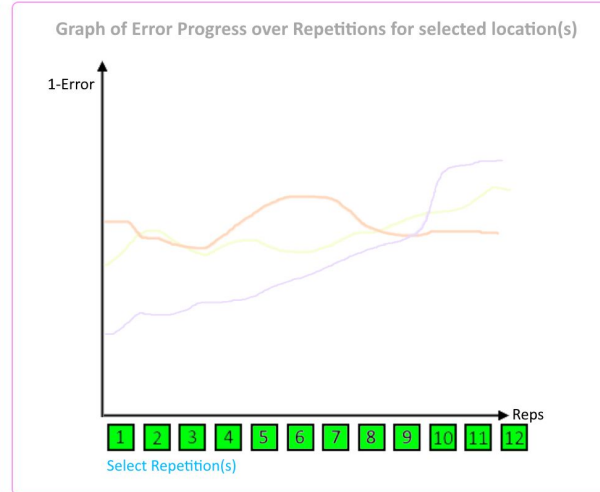
Error Location View:  
 Top Errors / Heatmap / Detail Inspector

Select Stroke(s) 1 2

Select view type  
 Top Errors  
 Heatmap



Top Errors Controls: Top 3 5 Order by   
 Biggest Individual Errors  
 Most occurring Errors  
 Least Progress Errors



# Analytics - Select Error Icon

General Overview Stats

	Big Errors	Correctness	Progress
Pressure	7	65%	None
Curvature	4	78%	Minor
Speed	21	72%	Good
Precision	2	86%	Minor
All Features	34	75%	Good

Exercise Information

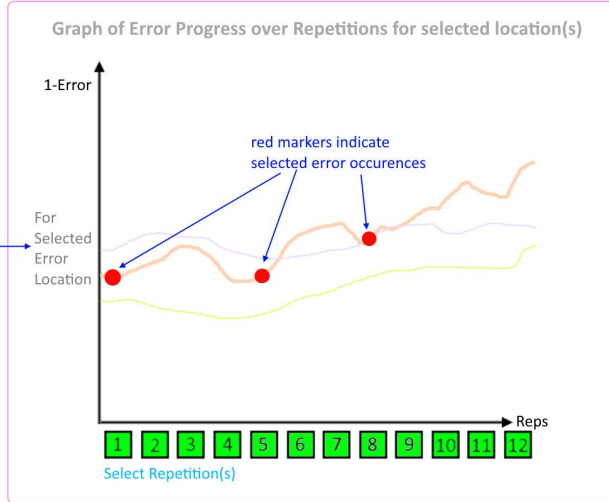
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 Exercise Description:  
 Trace over the capital letter "A" while focussing on tracing precision and producing straight stroke sections.  
 Repetitions: 12  
 Difficulty: 2/5

Error Location View:  
 Top Errors / Heatmap / Detail Inspector

Select Stroke(s) 1 2

Select view type  
 Top Errors  
 Heatmap

Error Icon  
 OnClick() 3 update progress view



Top Errors Controls: Top 1 5 Order by

- Biggest Individual Errors
- Most occurring Errors
- Least Progress Errors





# Workflow - "What went wrong?"

Top Errors Controls:

Top

3

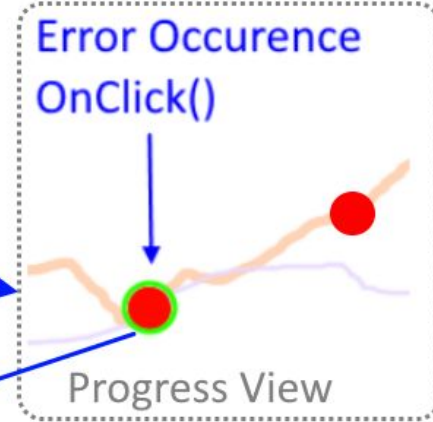
5

Order by

- Biggest Individual Errors
- Most occurring Errors
- Least Progress Errors

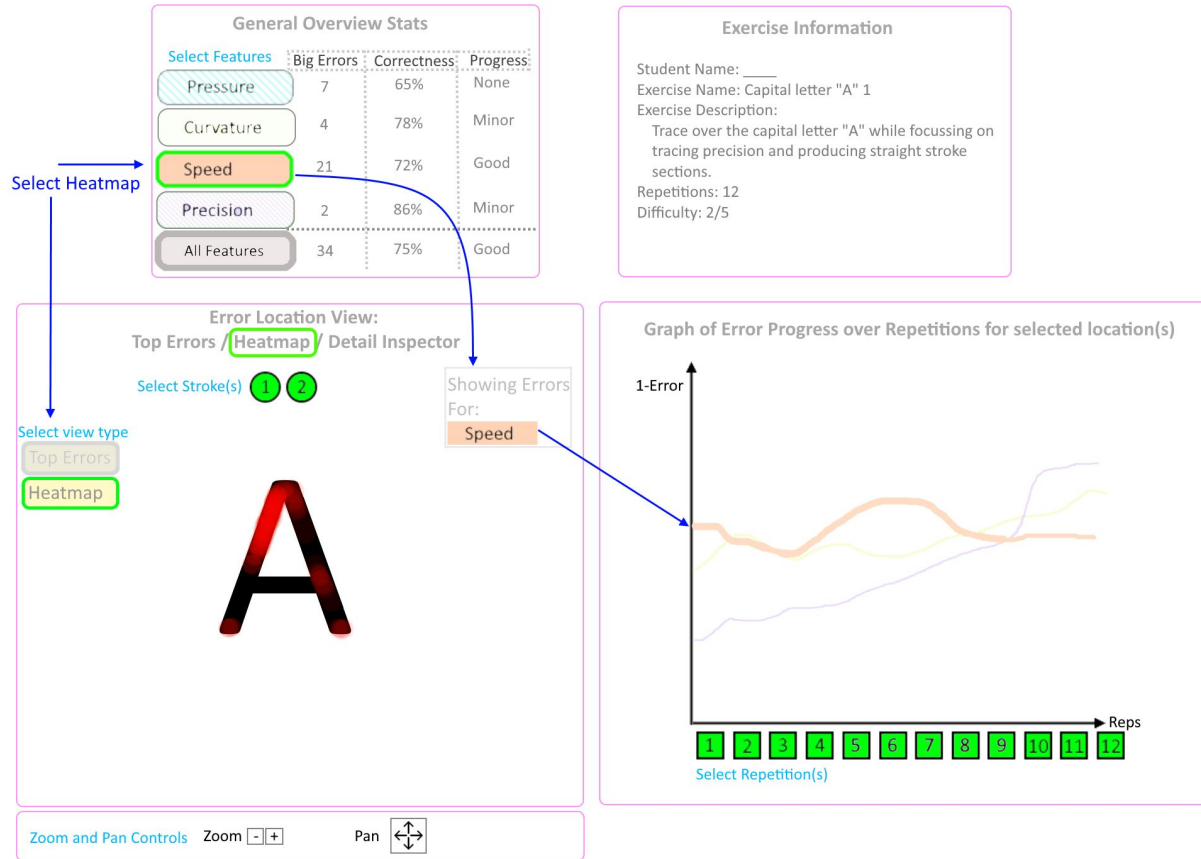


Highlight occurrences in  
progress view

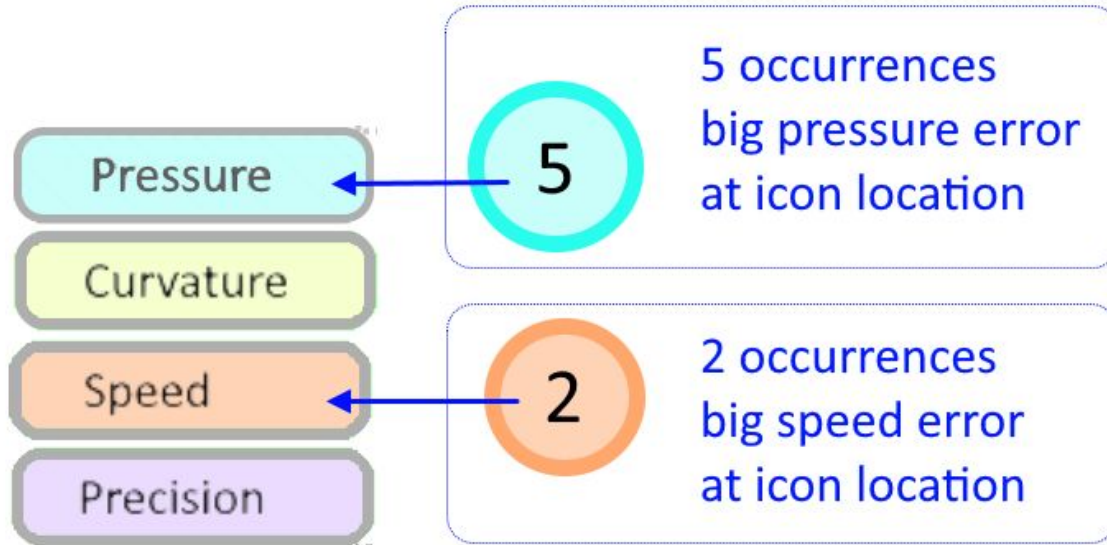


Switch Big Error View  
to Detail Psychomotor Skill  
Inspector

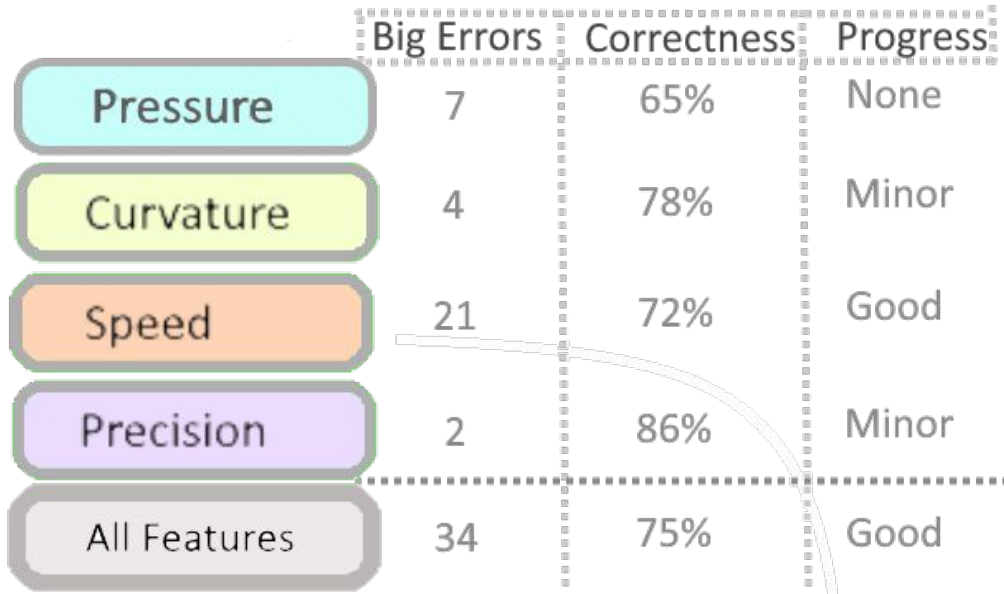
# Exercise Report Analytics - HWP Mastery



# Exercise Report Analytics - Big Error Icons



# Validation - Overview Stats



- This vis helped me estimate:
  - The student's biggest difficulties:  
1 2 3 4 5  
Strongly disagree ○ ○ ○ ○ ○ Strongly agree
  - The student's overall performance:  
1 2 3 4 5  
Strongly disagree ○ ○ ○ ○ ○ Strongly agree
- The following helped me answer the previous 2 questions:
  - The big error values
  - The correctness values
  - The progress values
  - The breakdown per feature

# Validation - Heatmap

Select Stroke(s)



Speed

Top Errors

Heatmap



- This vis helped me estimate:
  - The student's biggest difficulties:  
1 2 3 4 5  
Strongly disagree ○ ○ ○ ○ ○ Strongly agree
  - The student's overall performance:  
1 2 3 4 5  
Strongly disagree ○ ○ ○ ○ ○ Strongly agree
- The following helped me answer the previous 2 questions:
  - The selected stroke(s)
  - The selected feature(s)
  - The colors of the stroke(s)
  - The locations of the red color on the stroke(s)

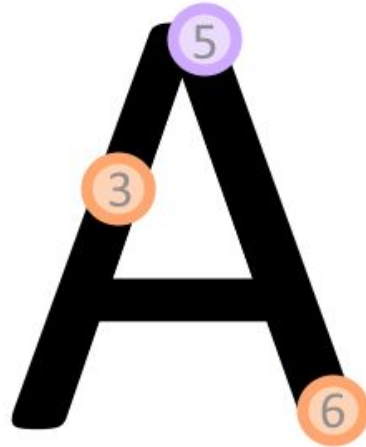
# Validation - Big Errors (TOP 3)

Speed

Precision

Top Errors

Heatmap

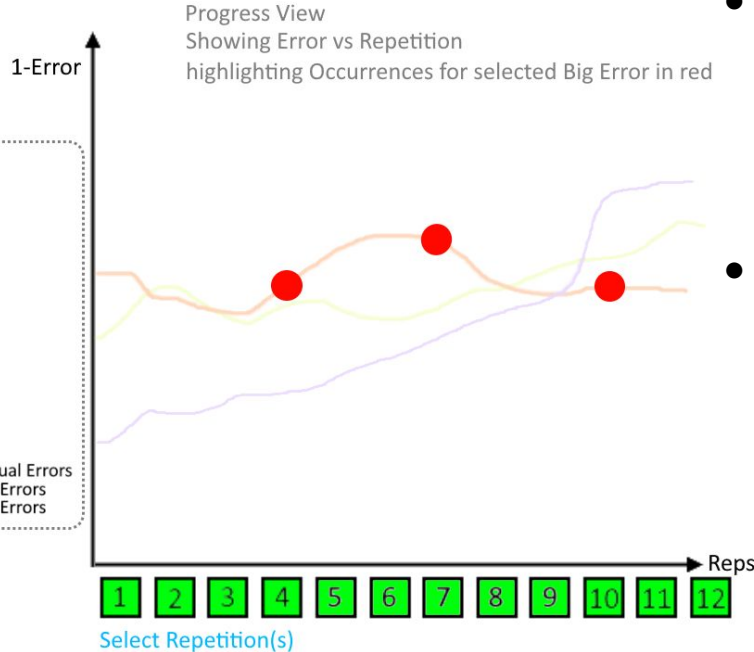
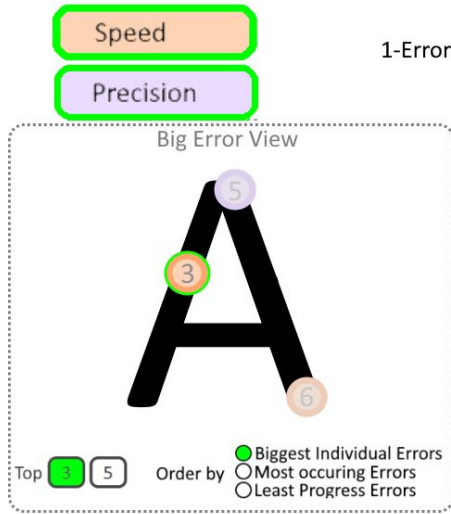


- Order by
- Biggest Individual Errors
  - Most occurring Errors
  - Least Progress Errors

Top  3  5

- This vis helped me estimate:
  - The student's biggest difficulties:  
1 2 3 4 5  
Strongly disagree      Strongly agree
  - The student's overall performance:  
1 2 3 4 5  
Strongly disagree      Strongly agree
- The following helped me answer the previous 2 questions:
  - The selection (highlighted in green)
  - The icon's numbers
  - The amount of icons
  - The icon colors

# Validation - Big Error selected



- This vis helped me estimate:

- The student's progress:



- The following helped me answer the previous 2 questions:

- The selected error
- The curves
- The red dots
- The selection (highlighted in green)

# Validation - Detail Inspector

*big error occurrence has been selected*

Detailed Inspector View


Speed


Select view type

Back to Top Errors

Too Fast ●

Too Slow ●



Zoom and Pan Controls Zoom - + Pan 

- This vis helped me understand:
  - The student's difficulties for the selected error:  
1 2 3 4 5  
Strongly disagree ○ ○ ○ ○ ○ Strongly agree
- The following helped me answer the previous 2 questions:
  - The key (the meaning of the colors)
  - The color location
  - The color intensity



# The likert questions

Thank you for listening!

Bibeg Limbu

b.h.limbu@tudelft.nl

# KiteVR

