

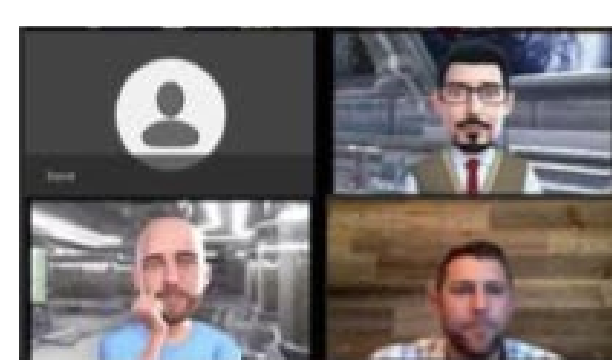
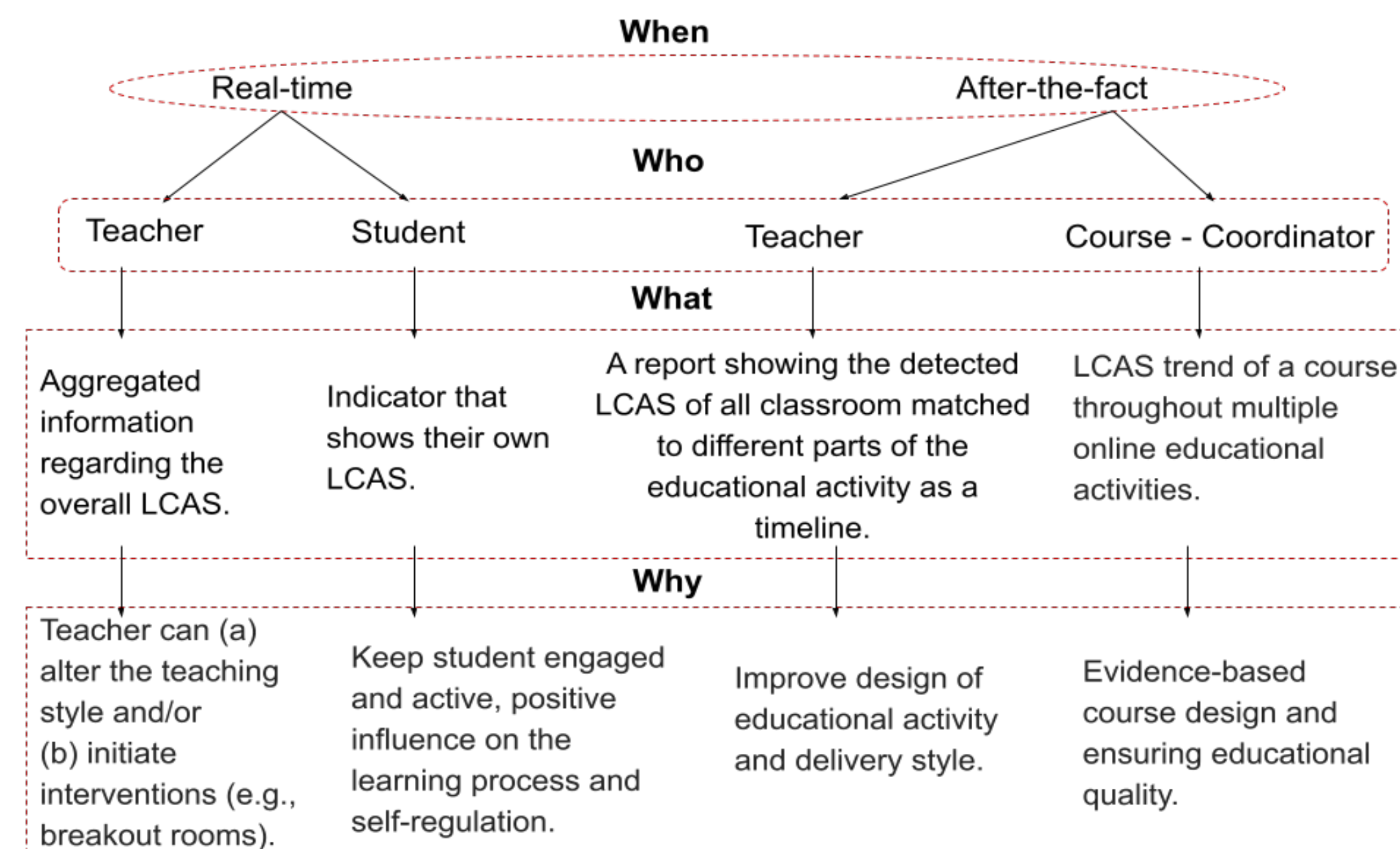


1. Introduction & Motivation

- Most educational institutions transitioned to online learning during the pandemic.
- Students get distracted under isolation and teachers have a lack of understanding of how the students are doing.
- We define the **learning-centered affective states (LCAS)** as the psychological, physiological, and emotional states that relate to the learning experience of students.
- By observing the visible learning-centered affective states, teachers may **adjust their teaching style** and improve the learning experience of the students.
- However, learning-centered affective states are not directly observable in synchronized online learning.
- We propose to **develop specialized multi-modal AI algorithms for the recognition of learning-centered affective states.**

3. Objectives

Information Flow



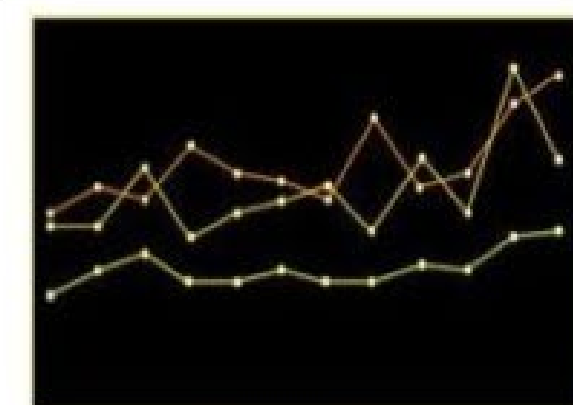
Participants in online course

Recognize:
 \$> Gestures and body postures
 \$> Micro expressions
 \$> Macro expressions
 \$> Other activities

AI models

Learning Centered Affective States

Overall Implementation



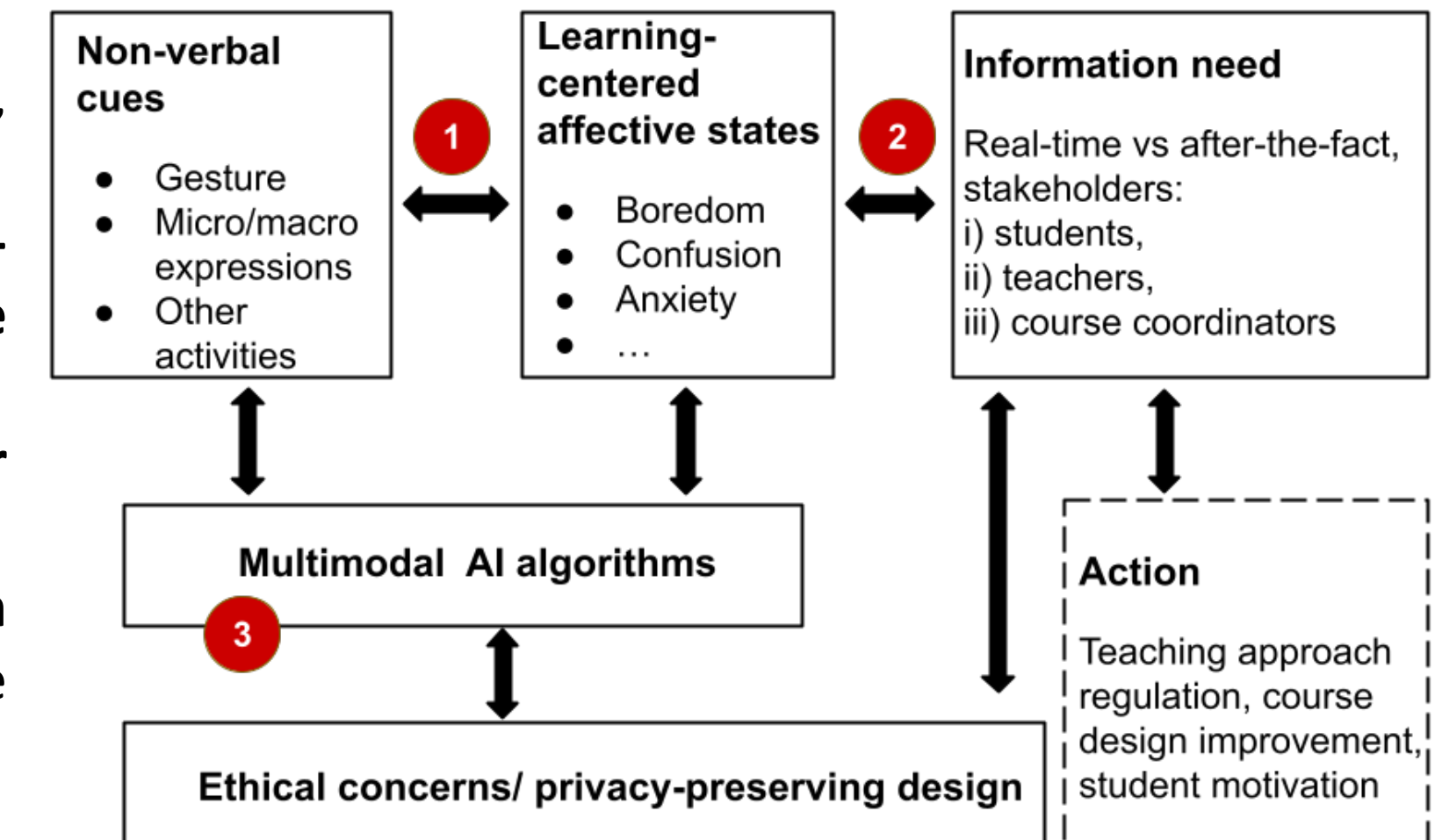
Feedback to the teacher

2. Methodology

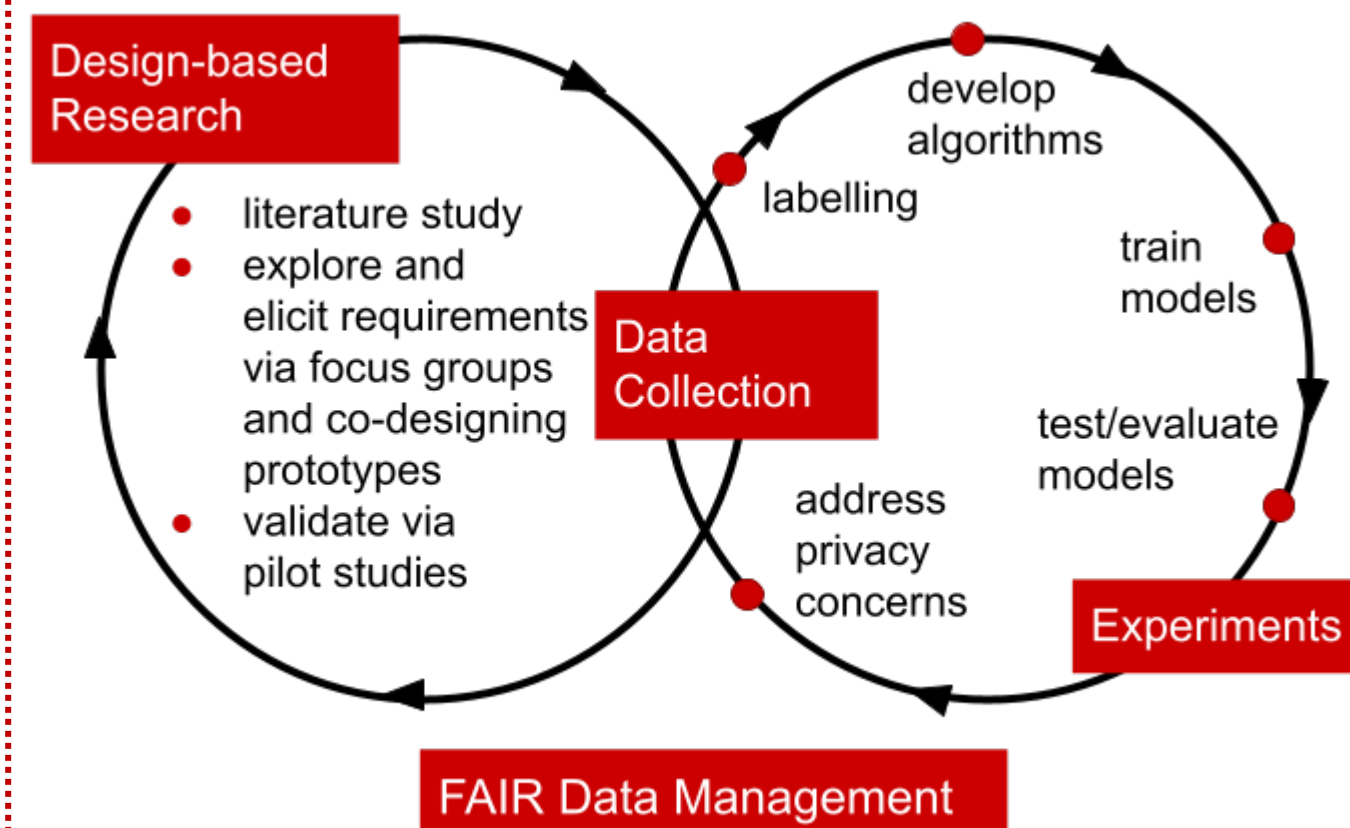
2.1 Research Models

Research model aims to use theories of learning, motivation and emotion in combination in order to:

- (1) **define** the relationship between **learning-centered affective states of students** and **observable non-verbal-cues**,
- (2) **develop** specialized **multi-modal AI algorithms for the recognition of learning-centered affective states**,
- (3) **design** tools to **present this information in an actionable way** for teachers and students to improve the learning process.



2.2 Research Approach



Employ Design-Based Research (DBR) experiments through multiple iterations, i.e., literature study, requirements elicitation, participatory design, and evaluation of the interventions (i.e., integrated AI models) in pilot studies of online learning.

The AI models will be developed through experimentation cycles (i.e., data collection, annotation, algorithm development and model training and evaluation).

We will develop algorithms, train and test Facial Expression Recognition (FER) – Gesture Recognition (GR), and the learning-centered affective states recognition AI models on multiple datasets to ensure generalizability.

2.3 Research Questions

- What are the **specific non-verbal feedback needs** of teachers and students in online lectures?
- How can we **automatically detect non-verbal cues** and **translate them to learning-centered affective states** in online, synchronous, educational activities?
- How can we **present this information to teachers** in real-time so that they can take actions to positively influence the learning-centered affective states of the students?
- How can we **provide students with this information** so that learning-centered affective states are positively influenced?
- How can we design a system that is **ethically sound**, respects **privacy concerns**, and keeps **all collected data secure**?

4. Discussion

- The outcomes of the experiments will allow us to gain a deeper understanding on how **learning-centered affective states** are indicated by observable non-verbal cues, and how these states can be related to an effective learning experience.
- To **protect the privacy of students** we design core privacy-preserving measures to shape our research around them. The training data will be collected **anonymously with no possibility to link to individuals.**