Project Report

ClassSense

Web-App for Classroom Climate and Focus Awareness

submitted by

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Contents

1 Introduction

1.1 Background

Swiss high schools (Gymnasien) are undergoing a significant transformation through the reform "Weiterentwicklung der gymnasialen Maturität" (WEGM). The reform emphasizes digital competence, media literacy, and self-regulated learning. As digital devices become integral to everyday teaching, teachers face new challenges: maintaining attention, managing distractions, and supporting students' emotional and cognitive well-being. ClassSense aims to address these needs with a user-centered web application that enables both teachers and students to monitor and co-regulate classroom climate in real time, respecting privacy and autonomy. These priorities align with broader trends in Swiss education policy, which emphasize wellbeing, autonomy, and sustainable learning environments.

1.2 Problem

Swiss high schools actively integrate laptops, tablets, and other electronic tools into the curriculum, classrooms are more lively but also more distracted. While digitalization releases creativity and the potential of information, it simultaneously makes it harder for teachers to get the class coordinated in concentration, interest, and emotional self-regulation. Researchers suggest that emotional classroom climate is a strong predictor of pupil engagement and performance (Brackett et al., 2011; Wang et al., 2020). Yet most schools still rely on the teacher's unassisted intuition to sense when attention is getting smaller. The WEGM approach underscores the need for privacy-respecting feedback instruments rather than invasive monitoring instruments. Teachers and students need a simple-to-use, privacy-respecting instrument for monitoring, understanding, and modulating class mood and focus in real time.

1.3 Goals

The development of ClassSense was driven by a set of functional and ethical design goals, with the objective of ensuring its suitability for everyday school use. The system was developed for the purpose of providing teachers with a real-time overview of the classroom climate by displaying an anonymous, aggregated distribution of student states (e.g., understood, confused, overloaded, tired). Feedback is refreshed within a few seconds, thereby enabling timely pedagogical decisions and supporting the link between emotional climate and engagement (Brackett et al., 2011; Reyes et al., 2012). Privacy-by-design is a core architectural principle of ClassSense. Students can send feedback without any form of login or identification. The system is designed to work without collection/storage of any personal identifiers. To support transparency, the project is done under the AGPL license. Finally, the additional workload for teachers must remain minimal.

1.4 Methodological approach

To ensure that ClassSense fits real classroom needs, we followed the Design Process Model showcased during User-Centered Design (UCD) led by D. Lalanne at the University of Fribourg. The project was structured around four iterative phases: Articulate, Brainstorm, Refine, Complete.

2 Exploratory study

2.1 Instruments and procedure

- Two online questionnaires (teachers + students) implemented in Microsoft Forms.
- Six semi-structured interviews (approximately 20 minutes), audio-recorded and transcribed.

Teacher questions focused on: how hard it is to judge engagement behind laptops, whether real-time feedback would help, preferred visualizations, attitudes towards environmental indicators, and privacy concerns.

Student questions focused on: willingness to report mood/focus, preferred input style, acceptable frequency/timing, and concerns about anonymity and surveillance-like features (tracking, cameras).

We surveyed 10 practising teachers and 45 students from a Gymnasium St. Klemens in Ebikon LU. Follow-up interviews were conducted with a subset of three teachers and three students.

2.2 Teacher perspective key findings

Teachers confirmed that judging class engagement with open devices is challenging. Sixty percent reported that it is at least sometimes difficult to read the class state in BYOD settings.

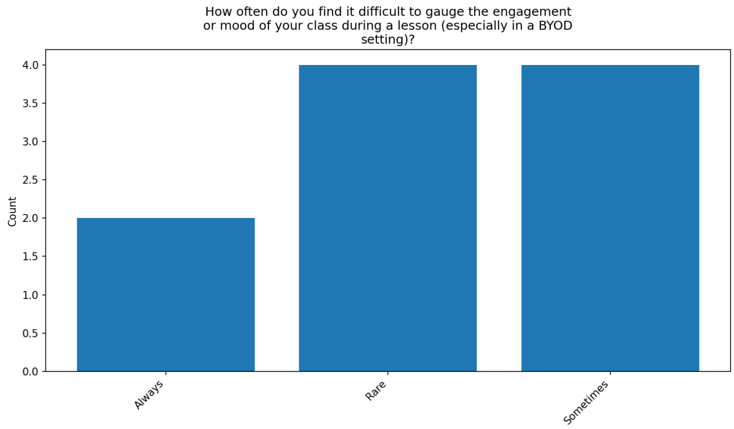

Figure 1: Difficulty in judging engagement (teacher survey).

They also preferred an aggregated view rather than individual-level tracking and asked for clear, simple visualisations (e.g., bars / percentages).

Figure 2: Preferred visualization features (teacher survey).

2.3 Student perspective key findings

Students were generally willing to provide feedback sometimes, but not continuously, and strongly required anonymity. They preferred a minimal, “background” interaction (fast taps, no typing, no full-screen overlays).

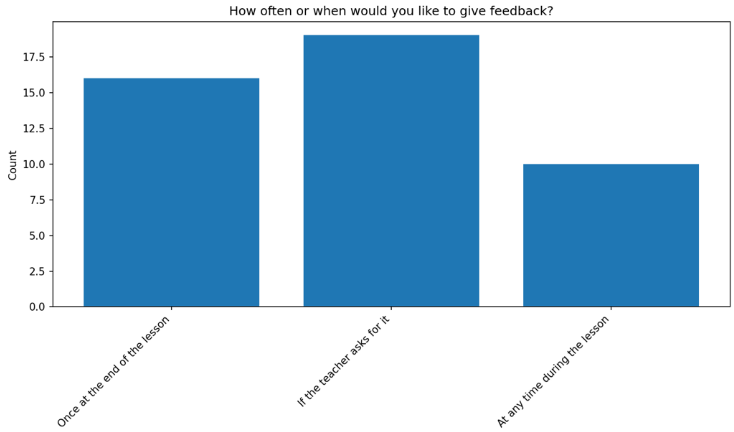

Figure 3: Preferred timing for student feedback during lessons (student survey).

Figure 4: Preferred interaction style for providing feedback (student survey).

2.4 Design consequences

The exploratory study led to these core design decisions:

- Anonymous one-tap student input with four central states (OK/continue, too fast/confused, overloaded/need break, tired/low energy).
- Aggregated class-climate visualisation for teachers (no identities, no individual histories).
- A teacher view designed for peripheral awareness (browser sidebar or external display).
- Optional environment indicators at room level only (noise/temperature/CO_2), not tied to individuals.

3 Personas and scenarios

3.1 Teacher personas

Based on the exploratory questionary and interview results, we have defined 3 teacher personas, 4 student personas and 3 scenarios. These objects will provide the ideas that will be later used in the prototype development.

Mr. Müller (42 years old, History/English, BYOD class)

- Pain points: cannot read the class once everyone looks at laptops; asks "Is the pace ok?" and gets silence; feels tired managing constant micro-adjustments.
- Motivations: wants to act early before the group drifts; wants feedback that does not expose individual students; wants a tool that runs quietly in the background.
- Design implications: teacher view must be simple, aggregated, and readable at a glance; needs immediate hints for action ("slow down," "pause"); privacy guarantee visible on the first screen.

Mrs. Brinkmann (28 years old, Mathematics/Physics)

- Pain points: multitasking on screens reduces engagement; wants evidence beyond intuition.
- Motivations: understand engagement across lesson phases; improve pacing and materials.
- Design implications: optional post-lesson summary; keep real-time view minimal for in-lesson use.

Mr. Zemp (58 years old, Languages)

- Pain points: feels saturated with new tools; fears student misuse or extra workload.
- Motivations: willing to try if privacy and simplicity are guaranteed.
- Design implications: onboarding must take under 3 minutes; use neutral visual design and clear labels; highlight "no extra admin work."

3.2 Student personas

Melanie (17 years old, organized, grade-oriented)

- Pain points: gets frustrated when the class slows down; does not want others' disengagement to waste time.
- Motivations: wants efficient pacing and clarity.
- Design implications: needs "OK / continue" option to express readiness; system must show that feedback from all sides balances the group.

Tim (16 years old, introverted, slow processing)

- Pain points: feels anxious when the teacher moves on too fast; avoids asking publicly for help.
- Motivations: wants a safe way to signal "too fast" or "overloaded."
- Design implications: one-tap anonymous input required; a system must confirm receipt ("Your input counted").

Jasmin (17 years old, avoids attention)

- Pain points: feels invisible; sees teacher unaware of general tiredness.
- Motivations: wants collective expression ("many of us are tired").
- Design implications: aggregated results must be visible to teachers only; no personal trace of participation.

Phil (16 years old, digitally fluent, easily bored)

- Pain points: bored quickly; task repetition triggers distraction.
- Motivations: wants variety and quick feedback loops.
- Design implications: short check-ins maintain re-engagement; interface should feel modern but minimal.

3.3 Scenarios

Scenario 1 – Live regulation

1. During a maths lesson, students tap icons: 30% “too fast”, 50% “OK”, 20% “tired.”
2. Teacher view flashes amber: “Overload rising.”
3. Teacher pauses 2 minutes, repeats the key step.
4. The next pulse shows 70 percent “OK.”

Outcome: Teacher prevents frustration; students see reaction; trust is reinforced.

Scenario 2 – Energy monitor in a double period

1. After 45 minutes, many students signal “tired.”
2. Teacher adds a micro-break and short pair task.
3. Energy score returns to the green zone.

Outcome: Maintains attention without disciplinary interventions.

Scenario 3 – Post-lesson review

1. ClassSense shows to the teacher an anonymous timeline: first 20 min = OK, middle = over-load, last = fatigue.
2. Teacher adjusts the next lesson by reducing input length and adding examples.

Outcome: Supports reflection without tracking individuals.

4 Design choices and design rationale

4.1 Core interaction principles

- **Low effort:** classroom interactions must be fast and require minimal attention. One-tap input reduces motor and cognitive effort compared to more precise interactions (e.g., sliders) (Fitts, 1954).
- **Peripheral awareness:** teachers need information “at a glance” without switching away from teaching materials.
- **Actionable signals:** the system should not only describe the state (“many confused”) but support plausible responses (slow down, clarify, short pause).

4.2 Student input design

We used four discrete, semantically clear states derived from the exploratory study:

1. OK / continue
2. Too fast / confused
3. Overloaded / need break
4. Tired / low energy

4.3 Teacher dashboard design

Two teacher views were designed to support different classroom workflows:

- A compact status bar to keep the signal visible on the main teaching device.
- A full-screen dashboard intended for a secondary/external display so the teacher can monitor the class climate in peripheral vision.

External displays can reduce disruptive task switching compared to dashboards embedded in the same workspace (Czerwinski et al., 2004).

4.4 Visual style

Exploratory interviews suggested that the tool must feel supportive rather than supervisory. We used:

- Calm layouts with restrained colours (traffic-light-inspired but non-alarming).
- Short, neutral wording (no judgmental phrasing).
- Minimal animations and no attention-grabbing pop-ups by default.

4.5 Privacy-by-design

Privacy and trust were treated as first-order requirements:

- No logins and no personal identifiers.
- Only aggregated, session-level information (no individual histories).
- Optional environment sensing is room-level only and never linked to individuals.

5 Low-fidelity prototype

5.1 Teacher prototype

We created two dashboard layouts: a compact status bar and a full-screen dashboard. Interactive Figma prototypes were implemented.

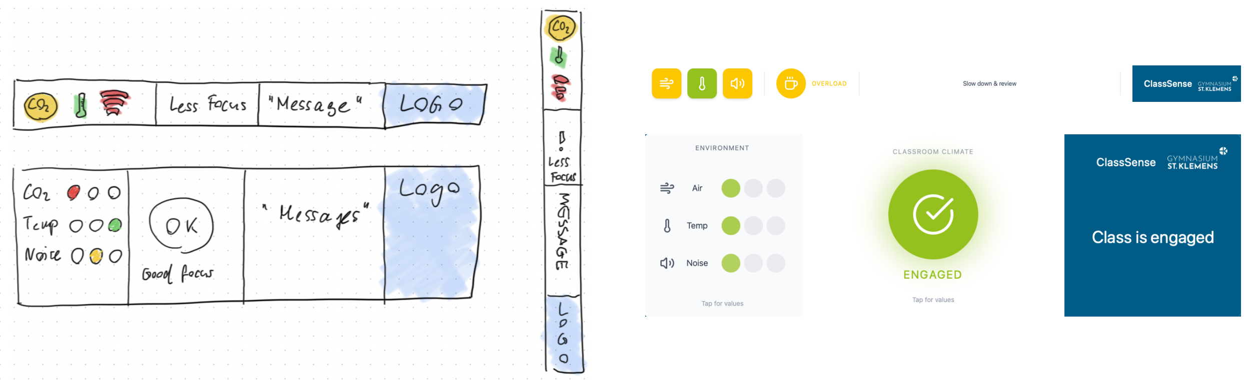

Figure 5: Teacher UI concepts: paper prototype with alternative layouts (left) and corresponding digital mock-ups (right).

5.2 Student prototype

We first sketched both concepts as paper prototypes. Then we implemented both variants in Figma to validate tap targets, layout, and visual calmness. Two interaction variants were developed:

- **Buttons:** one-tap input for four states (OK, confused, overloaded, tired).
- **Sliders:** more nuanced expression, but higher precision and attention demands.

Figure 6: Student UI prototypes: paper prototype (left) and Figma prototype (right).

6 Controlled evaluation

We conducted a within-subject controlled experiment to compare two interface variants for students (**buttons vs. sliders**) and two dashboard configurations for teachers (**browser dashboard vs. external-screen dashboard**). A within-subject design was used to reduce inter-individual variability, and the order of conditions was counterbalanced (half A→B, half B→A).

Participants included two secondary school classes of students (n = 26) and practising teachers (n = 7), all working in a BYOD setting. Due to hardware constraints, all trials were conducted using a single shared setup consisting of one sensor device and one external display.

6.1 Hypotheses

H1 (students): A button-based UI will be rated higher in terms of usability, be less disruptive, and be more readily adopted than a slider UI.

H0 (students): There is no discernible difference between button and slider UIs with regard to usability, disruptiveness, or user willingness to engage with them.

Dependent variables	Independent variable
Perceived usability Perceived disruptiveness of class flow Willingness to use	Input type (buttons vs. slider)

H1 (teachers): A dashboard on a separate external screen will be rated as more practical and desirable to adopt than a browser-only dashboard.

H0 (teachers): The placement of the dashboard had no discernible impact on the perceived practicality, ease of use, or intention to use it.

Dependent variables	Independent variable
Practicality / workflow fit Perceived usability Adoption intention	Dashboard location (WebApp in Browser vs. external screen)

6.1.1 Measurements

All subjective measures were collected via Microsoft Forms questionnaires using 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). For each condition, we measured: Perceived usability; Perceived disruptiveness / practicality in class; Adoption intention

We also collected forced-choice preferences (which version would you use in class?) and logged reaction-time traces for student input.

In addition to questionnaire data, we logged interaction times for students (timestamps from start of interaction to completed input) to compare reaction times between the two input variants.

6.1.2 Procedure

Students (~15 min):

1. Introduction (1 min): Clarification that the goal was to compare user interfaces.
2. Condition 1 (5 min): Students used the first variant (buttons or slider), triggered by 3–5 feedback prompts during an authentic learning sequence.
3. Questionnaire 1 (2 min): Immediate evaluation of usability, disruptiveness, and willing-ness to use.
4. Condition 2 (5 min): Students switched to the alternative version using the same interaction prompts.
5. Questionnaire 2 (2 min): Evaluation of the second version followed by a forced-choice preference question.

Teachers (~15 min):

1. Introduction (1 min): Short explanation of the dashboard indicators and intended sup-port.

2. Condition 1 (5 min): Teachers conducted a short instructional task while using the first dashboard configuration.
3. Questionnaire 1 (2 min): Immediate subjective evaluation.
4. Condition 2 (5 min): The same task was repeated with the alternative dashboard setup.
5. Questionnaire 2 (2 min): Second evaluation and final preference question.

The controlled evaluation was run in short sessions (approximately 15 minutes per participant group) in a BYOD-like setup to approximate realistic classroom constraints.

7 Analysis of evaluation results

7.1 Student UI: buttons vs. sliders

A paired-samples t-test showed no statistically significant difference in perceived usability between the button interface (M = 3.76, SD = 1.13) and the slider interface (M = 3.68, SD = 1.00), $t(25) = 0.46, p = 0.65$. Because disruption ratings were not normally distributed, a Wilcoxon matched-pairs signed-rank test was applied, revealing no significant difference between buttons (M = 3.60, SD = 1.02) and sliders (M = 3.23, SD = 1.21), $p = .152$. Figure 7 and Figure 8 summarise the mean ratings and standard deviations for both measures.

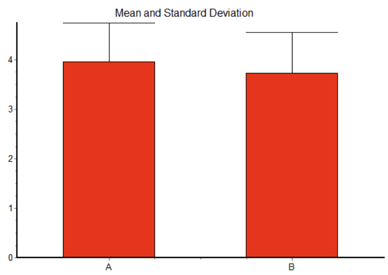

Figure 7: Mean and standard deviation of student usability ratings (buttons vs. sliders).

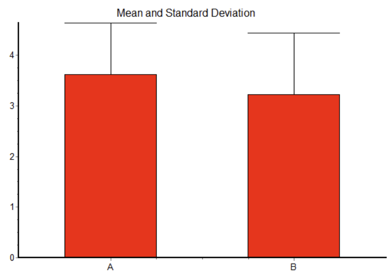

Figure 8: Mean and standard deviation of perceived disruption during class (buttons vs. sliders).

Adoption intention did not differ significantly between the button interface (M = 3.69, SD = 1.03) and the slider interface (M = 3.54, SD = 0.98), as indicated by a Wilcoxon matched-pairs signed-rank test ($p = .34$). In contrast, reaction-time data revealed a clear efficiency advantage for buttons. Because distributions were non-normal and observation counts differed between conditions (buttons: $n = 516$, sliders: $n = 89$), a Mann–Whitney U test was applied. Students responded significantly faster using buttons (median $= 80$,ms) than sliders (median $= 514$,ms), $U = 11576, p < 0.0001$. Figure9 and Figure10 illustrate the mean values and standard deviations for both measures.

7.1.1 Preference

Despite similar Likert ratings, forced choice showed a clear preference: 19/26 students preferred buttons (binomial test p = 0.040). Button supporters described the interaction as faster and less distracting, while slider supporters valued precision.

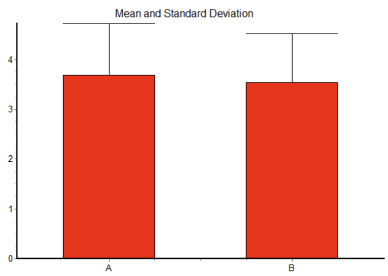

Figure 9: Mean and standard deviation of student adoption intention (buttons vs. sliders).

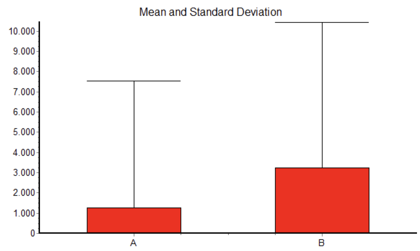

Figure 10: Mean and standard deviation of reaction time for student feedback (buttons vs. sliders).

7.2 Teacher dashboard: browser vs. external screen

Teachers reported high usability for both dashboard configurations. A paired-samples t-test showed no statistically significant difference between the browser dashboard (M = 4.21, SD = 0.86) and the external-screen dashboard (M = 4.64, SD = 0.38), $t(6) = 1.35, p = 0.225$. Practicality and perceived disruption were likewise comparable across conditions. Using a Wilcoxon matched-pairs signed-rank test, no significant difference was found between the browser version (M = 3.71, SD = 0.76) and the external-screen version (M = 4.43, SD = 0.53), $p = 0.25$. Figure 11 and Figure 12 summarise the mean ratings and standard deviations for both measures.

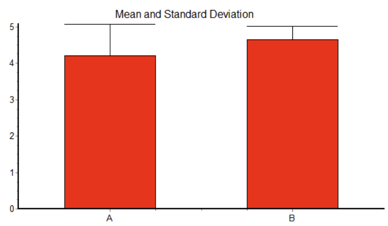

Figure 11: Mean and standard deviation of teacher usability ratings (browser vs. external screen).

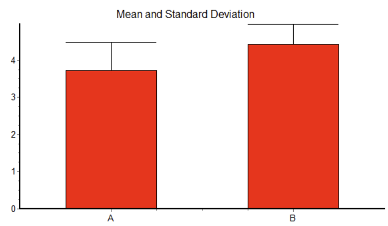

Figure 12: Mean and standard deviation of teacher practicality/disruption ratings (browser vs. external screen).

7.2.1 Adoption intention

Adoption intention also showed no significant difference (Wilcoxon, p = 0.25), but the external screen trended higher: browser (M = 3.86, SD = 0.63) vs. external screen (M = 4.36, SD = 0.48).

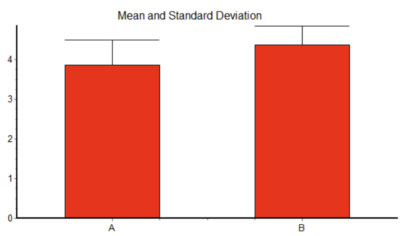

Figure 13: Mean and STD for adoption intention (A = browser, B = external screen).

7.2.2 Preference

Forced choice revealed a strong preference: 6/7 teachers chose the external-screen dashboard. Teachers reported that an additional screen avoids window switching, keeps teaching materials visible, and supports continuous peripheral awareness.

7.3 Discussion and implications

Across both groups, the dominant theme was *low effort* + *high trust*. Students reacted significantly faster with one-tap buttons, supporting the central design principle that in-class feedback must be nearly effortless (Fitts, 1954). Teachers preferred the external-screen setup because it integrates better with real teaching flow and reduces disruptions from task switching (Czerwinski et al., 2004).

Overall, ClassSense appears feasible and desirable in a BYOD secondary school context—provided it remains anonymous, aggregated, and calm in its visual behaviour.

7.4 Limitations and next steps

- Sample sizes were modest (n = 26 students, n = 7 teachers), and sessions were short, limiting generalisability and long-term adoption claims.
- The evaluation focused on UI comparison; longer deployments are needed to assess habituation effects and real classroom impact.
- Future iterations should refine accessibility beyond colour choices (icons, text alternatives) and evaluate whether environment indicators meaningfully improve teaching decisions.

8 Retrospective

Firstly, in the early phase, we considered approaches such as app usage tracking and camera-based emotion detection. However, these ideas were strongly rejected by students in the exploratory study. The original intention of this idea was privacy-driven, and it would not collect more data than what students already share when they tap a button. However, this was not made clear enough in our introduction. Questions could have been framed more carefully to avoid creating the impression of surveillance. Secondly, the interview phase could have been extended to include multiple rounds. If there had been more time, an additional round of interviews after the first prototype refinement would have helped to validate whether the early design interpretations (e.g., the four core states, the calm visual style, and the additional teacher view) truly matched real classroom expectations, before moving on to the controlled experiment. Thirdly, the technical architecture was designed to be functional and lightweight within the course timeline. With more development time, the backend and data pipeline could have been improved for more stable classroom use. Overall, these points do not change the general direction of the project. However, we present them to show where the process could be strengthened.

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