**# Discussion**

## Summary of key findings

The two main goals of this study were first to investigate the use of wearable fitness trackers as a new method to assess teachers’ HR throughout a five-phase lab study, including a micro-teaching unit. Secondly, we examined whether variance in HR measures can be explained by teachers’ teaching experience, and by self-reported cognitive appraisal (disruption appraisal and confidence appraisal) of classroom events.

We examined whether

The visualizations and analyses of the HR data in the five different phases and throughout the entire study clearly showed that wrist-worn fitness trackers are a suitable method for measuring different states of arousal in (prospective) teachers in a laboratory setting.

predict the subjects’ HR with self-report results mainly confirmed our hypotheses: First,

## Limitations

As with all research, methodological limitations need to be considered.

Firstly, the laboratory setting of the study did not correspond to an authentic classroom environment. The data collected during the micro-teaching unit in a highly standardized situation was based on a fictional setting, resulting in various aspects, such as the lack of a teacher-student relationship. Nevertheless, researchers agree that positive relationships are the basis for effective classroom management and productive handling of classroom disruptions [@ruedi2014; @beaty2010]. For this reason, it cannot be excluded that the artificial laboratory situation led to an increased HR of the subjects due to nervousness and excitement. However, these conditions were identical for all participants, meaning that

Secondly, the subjects’ resting HR was not recorded during the study, although this is an important marker to consider inter- and intrapersonal cardiovascular differences in subjects [@nanchen2018; @heneghan2019]. For this purpose, it is necessary to record the HR during a resting phase without physical or emotional stress, ideally fifteen minutes before the beginning of the activity, to determine a valid baseline HR. This is a necessary condition when carrying out tests in the laboratory, but in practice, it can be a challenge to achieve these conditions [@sammito2015guideline] due to time constraints and difficulties in the acquisition of participants. To account for individual differences in the baseline HR without measuring the resting HR for 15 minutes, we z-standardized the BPM values from participants’ mean HRs (see ## in the Method Section).

Third, previous research has discussed the limitations of self-report data due to methodological bias [@pintrich2003; @parker2012]. pintrich2003 suggests the collection of other measures such as physiological or behavioral data in addition to self-report data to build a stronger empirical base. However, self-report data can be useful to capture intra-psychic constructs as they are in the case of this research.

## Practical Implications and Hands-On Tipps with Wearables

The results of our study point to several important implications.

The increasing availability of HR data through wearable fitness trackers offers consumers the opportunity to self-monitoring important mental health indicators such as HR as an indicator of stress, beyond traditional self-reporting or expensive, intrusive ECG devices. Using fitness trackers could enable teachers to strengthen their self-awareness in stressful situations and allow for early self-intervention. Research on mental health has shown that to achieve a regular and meaningful use of fitness trackers as mental health monitoring, it would be essential for the subjects to understand the purpose of using the fitness watches as well as the meaning of the data [@ng2018].

Important aspects to consider for future research when using wrist-worn fitness watches include, noting the time to make the HR measurable at different intervals, e.g., to replicate findings on whether HR differs in teacher-centered and student-centered activities using fitness trackers [@junker2021]. Another point would be the collection of further external factors (social, personal, psychological, environmental, and behavioral) that influence HR, e.g., by questionnaires, to be able to make statements about the individual health and fitness status of the subjects [@wang2022].

Future research could use low-cost and non-invasive devices to accompany teachers in their everyday school practice to gain insight into teachers’ stress experience during teaching. Even in teacher training, wearable fitness trackers during internships could provide new insights into the stress experience of student teachers. Thus, the evaluation of the data with the subjects could provide clues as to which moments in the teaching profession and teacher training are experienced as particularly stressful to discuss and implement possible stress-reducing measures in teacher training.

## Conclusion