**APPENDIX**

**## Practical implications for teachers and researchers**

Bearing in mind the limitations outlined above, our findings suggest that wrist-worn, low-cost, and nonintrusive fitness trackers are a promising tool for recording HR as an indicator of stress in educational and academic settings, with practical implications. Below, implications for teachers and teaching training will be presented, followed by advice for researchers considering measurements with fitness trackers.

Most importantly, the increasing availability of HR data from wearable fitness trackers offers teachers the opportunity to self-monitor important mental health indicators such as HR. Using fitness trackers could enable teachers to strengthen their self-awareness in stressful situations and allow for early self-intervention such as mindfulness techniques (e.g., deep breathing or body scans) [agyapong2023interventions]. Furthermore, fitness trackers could advance teachers’ awareness of the interplay between teaching practice and physiological as well as psychological variables. For example, increased HR during teaching was shown to be linked to less effective and sometimes confusing prosody patterns in intonation, pace, and pausing [@tobin2016expression]. Research on mental health suggested that a regular and meaningful use of fitness trackers for mental health monitoring requires expertise [@ng2018]. A lasting benefit of tracking for personal health management may require teaching offers in which educators learn to use fitness trackers correctly and how to handle and interpret the data.

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 in daily life. Even in teacher training, wearable fitness trackers could provide new insights into the stress experience of student teachers during internships. The SRI method has proven very insightful for adding the teacher’s own perspective to the recordings of their teaching and physiological data. Evaluating data from fitness trackers, possibly together with video recordings of their lessons, could provide teachers and students with clues as to which types of situations are particularly stressful, and foster the implementation of stress-reducing measures in teacher training. Accordingly, the combination of subjective self-reported data such as interviews or questionnaires and objective measures such as HR would be an important step towards understanding and alleviating stress in the teaching profession.

For researchers aiming to use fitness trackers to collect data, there are practical aspects to consider concerning the planning, data collection, and follow-up procedure of studies [for an additional overview, see @nelson2020guidelines]:

1) Before data collection, researchers need to decide which model of fitness tracker best suits their research question. Whether the study will be conducted in the laboratory, in a medical environment, or under actual real-world conditions should guide this choice. Conventional fitness trackers should not be used if the focus is on measurement accuracy, such as in medical contexts, as they cannot replace ECGs [@gagnon2022]. Moreover, researchers should consider that measurement accuracy also depends on the intensity of the movements performed by the participants during data collection. Fitbit® fitness trackers underestimate HR at higher exercise intensities such as cycling [@thomson2019heart; @montoye2017comparative; @jo2016; @jachymek2021]. For reference, the systematic review by @fuller2020 provides a detailed overview of studies that used wrist-worn fitness trackers between 2000 and 2019 and discusses their validity and reliability. Another point that is decisive when choosing a fitness tracker model is the price. Between €30 and up to €1.700 for medical wristbands all price ranges are possible, depending on the research aim and budget. Currently, models assessing HRV in addition to HR are becoming more and more affordable and widespread. Still, Fitbit® fitness trackers might be ideal for teams operating with moderate budgets or if larger groups of participants need to be tracked at the same time. Before conducting any study, it should be considered that the data collected with fitness trackers is health data, and therefore very sensitive. Researchers have to ensure that data is treated following ethical guidelines on, for example, participants’ anonymity and secure storage.

2) Before and during data collection, decisions must be made regarding the circumference, attachment, and placement of the fitness tracker. The circumference depends, for example, on the age or physics of the participants. Thus, studies conducted for example with children should take into account the small wrist size when attaching the band. When putting on a fitness tracker, attention must also be paid to whether it is attached to the dominant or non-dominant wrist, as this can influence HR measurements. In terms of placement, researchers should note that different models of fitness trackers need to be placed differently and in line with the manufacturer’s instructions. It is also important to check that the battery is fully charged each time, that the latest version is loaded on the software and that the fitness tracker has been synchronized with the software before recording data to avoid unnecessary loss of data. Finally, if researchers want to investigate parameters in different time intervals as in our study (e.g., HR in lessons vs. breaks during the school day), it would be advisable to synchronize the fitness tracker with other watches to be able to determine the on- and offset of certain intervals/ time of interests.

3) As far as the further procedure for processing the data is concerned, researchers should ensure that the raw data of the physiological measurements are available for further analysis. For the Fitbit® HR measurements, for example, the raw data can be downloaded from a website in the form of .csv files. However, these must be downloaded as soon as possible to prevent loss. During follow-ups, it is also important to ensure that the data is reliably collected at the intended sampling rate. The model we used states that the fitness tracker records the heart rate every 1-5 seconds (depending on the movement). In our actual data, however, we sometimes only had HR measurements every 15 seconds due to participants’ movements and attachment of the fitness tracker.

**Figure XX**

*Laboratory setting of the micro-teaching unit. Note. The setting included three actors as the class (left) and a teacher (participant, right).*

*Ein Bild, das Mobiliar, Stuhl, Kleidung, Schuhwerk enthält.

Automatisch generierte Beschreibung*

**Figure XX**

*Laboratory setting of the interview. Note. The experimenter and participant watched the previously taught micro-teaching unit on video.*

Ein Bild, das Mobiliar, Zeichnung, Entwurf, Tisch enthält.

Automatisch generierte Beschreibung

**Figure XX**









