Exploring Future Teachers' Acceptance of Wearable Technologies for Anxiety and Stress Management: A TAM-Based Study

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Abstract

This study employs Davis's (1989) Technology Acceptance Model (TAM) to investigate future teachers' perceptions of wearable technologies for anxiety management. Wearable devices capturing physiological data are increasingly prominent in educational and psychological literature. Wearables can be worn on the wrists and hands for non-invasive, real-time monitoring of signals such as heart rate and electrodermal activity. Modern-day pressures create unique stressors for future educators, including balancing training and assessment demands, administrative burdens, and uncertainty regarding future positions. Accordingly, such devices offer innovative solutions by monitoring early physiological indices and prompting awareness. Understanding the technological adoption factors is essential for initiating their use in educational settings. The sample consists of student teachers enrolled at the University of Palermo, responding to a questionnaire based on TAM constructs: perceived usefulness, perceived ease of use, attitudes towards and intention to use. Items examine pre-service teachers' perceptions of wearable technologies for managing anxiety related to being a student teacher. The research design uses multiple regression techniques to explore factors predicting intentions to use wearable technologies. Results can offer insights into the practical implications for developing targeted teacher training programs that address concerns surrounding the usefulness and usability of wearables. Thus, informing strategies to enhance usability, like designing intuitive interfaces, alongside awareness initiatives such as interactive workshops to promote understanding and engagement.

Keywords: wearable technology, teacher wellbeing, technology acceptance model, pre-service teachers, stress management

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Introduction

The teaching profession is increasingly related to high levels of anxiety and stress. Pre-service teachers, often navigating new professional environments as well as the demands of their training courses, experience unique stressors and a vulnerable period of uncertainty and new challenges. As a result of this, attention has turned to seeking new methods of promoting emotional well-being amongst future educators.

Wearable technologies offer innovative methods of managing psychological stress through real-time monitoring and biofeedback of physiological states and markers of stress. Devices with specialised biosensors provide users with physiological data that can be used to manage these states through self-regulation techniques. When integrated successfully, these tools could enable pre-service teachers to manage their stress proactively, thus supporting self-regulation and self-management of anxieties at a time when wider, institutional support may not always be readily available.

Despite the growing body of research surrounding such wearable devices within the contexts of education and mental healthcare, there are limited implementations of these devices within teacher and, specifically, teacher training contexts. An important foundation of any integration of new technologies in new contexts is an understanding of the perceptions of the future users, in order to understand factors that may motivate adoption. This study explores pre-service teachers' acceptance of wearable technologies using the Technology Acceptance Model ([TAM], Davis, 1989), offering new insights into the perceptions of future educators of wearable technologies for anxiety and stress management.

Background

The role of the teacher has evolved significantly in recent years; teachers now have responsibilities beyond solely delivering subject content and regular teaching activities, including emotional support for students and the efficient use of ever-changing and new technologies (*UNESCO*, 2024). These changes have not only impacted teacher stress levels due to intensified workloads, but also due to the new emotional demands that come with being a teacher in the present climate. It has been reported that burnout is increasing (Turner & Garvis, 2023), and such burnout contributes to teachers leaving the profession, with attrition levels also on the rise. The teaching profession today requires teachers to provide a significant amount of emotional labour, where educators are now having to not only focus on their already demanding teaching duties, but also look to regulate and coregulate emotions with students in order to provide safe emotional environments, especially in the context of inclusive classrooms. In a systematic review, Kariou et al. (2021) found a significant association between emotional labour and teacher burnout, which has also been linked to reduced teaching efficacy and early departure from the profession. Furthermore, teacher emotions impact not only the teacher's own well-being but also the entire classroom environment. Teacher emotions have been found to influence student outcomes (Pi et al., 2022), academic achievement (Madigan & Kim, 2021) and teaching efficacy (Aldrup et al., 2024). Moreover, associations have been revealed within student-teacher interactions and student wellbeing (Braun et al., 2020; Frenzel et al., 2021), further highlighting how positive emotional interactions support co-regulation and thus self-regulation development processes for students. Sáez-Delgado et al. (2022) demonstrate that emotionally regulated teachers create emotionally safer learning environments, supporting students' social-emotional growth. In turn, this could foster improved student behaviour, engagement, and outcomes.

Whilst there exists a body of research for anxiety and stress within in-service teachers, research regarding anxiety in pre-service teachers remains limited, despite this being a known time of increased vulnerability (Gorospe, 2022) in which pre-service teachers face additional pressures, including feelings of unpreparedness, anxiety over future careers, and performance in new placement positions. These factors all contribute to heightened anxiety levels before they even begin their professional, in-service careers, and whilst they are still developing their professional identities, meaning that these early experiences can have potentially long-lasting effects on their confidence in classrooms and professional environments. Given the aforementioned importance of emotional regulation within the teaching career, teacher education programs signify an important period for the development of healthy anxiety and stress management skills. Early intervention could therefore help prevent burnout and improve teacher resilience and retention, and for this reason, the present study focuses on pre-service teachers.

In order to address pre-service teacher anxiety and stress, it is first important to be able to successfully measure it. Emotion is a complex concept to accurately measure, and self-report data, when used alone, comes with the risk of bias. Data triangulation includes the use of multiple sources or methods to enhance the credibility and validity of findings (Noble & Heale, 2019; Sciberras & Dingli, 2023). Within the digital era, new technologies offer opportunities to improve and support the well-being of teachers throughout their careers. Technologies such as wearable devices can measure physiological markers of anxiety, including electrodermal activity (EDA), heart rate, and heart rate variability (HRV), offering objective measurements and insights into stress (Meijer et al., 2023). While these tools are at present mainly used within student samples (Betancourt et al., 2017), for concepts such as behaviour prediction or attention monitoring, there is a potential for applying these to teacher contexts, especially for pre-service teachers who may benefit from such insights. Combining subjective self-reports with objective physiological measures from wearables could provide a more accurate comprehension of teacher emotions and stress.

From a critical disability studies perspective, technologies should be developed with intentionality and inclusivity. Researchers have raised attention to the need to critically inquire into the field of assistive technologies, arguing for the design of technologies with the users, ensuring that diverse needs and contexts are addressed through conscious and coproduction approaches (Mankoff et al., 2010; Williams & Gilbert, 2020). For pre-service teachers, involving their perceptions for guiding the design of wearable-supported stress management tools and integrations into curriculums could increase usability, acceptance, and relevance. Therefore, collecting the perceptions of pre-service teachers and understanding what would guide their adoption of such technologies is a crucial foundational step. The Technology Acceptance Model ([TAM], Davis, 1989), an adaptation of the Theory of Reasoned Action, has been used within educational contexts (Antonietti et al., 2022; Dele-Ajayi et al., 2019; Scherer et al., 2018) and stands as a valid tool for understanding the factors that impact technology adoption.

Teacher burnout is a growing global issue, the shift to teaching in a digital era has brought new possibilities for supporting teacher well-being through technologies such as wearable devices capable of monitoring physiological stress markers. When combined with data triangulation and inclusive design principles, such technologies could enhance both the measurement and management of pre-service teacher anxiety. However, it is important to understand how pre-service teachers perceive and would potentially adopt these tools. This gap underscores the rationale for the present study, which examines pre-service teachers'

acceptance of wearable technologies for anxiety and stress management using the constructs of the Technology Acceptance Model (Davis, 1989).

Research Questions

- How do future teachers perceive wearable technologies for anxiety management?
- What factors predict future teachers' intentions to use such technologies?
- Using the constructs of the Technology Acceptance Model (Davis, 1989), how do perceived usefulness, ease of use, and attitudes towards use influence participants' behavioural intentions to use wearables in the context of anxiety and stress management in teacher training?

Methodology

Research Design

A quantitative, cross-sectional survey design was employed to assess participants' acceptance of wearable technologies through TAM constructs. Participants were introduced to the concept of wearable devices for measuring physiological markers of anxiety and stress, and thus their potential use for wellbeing management, by a brief talk from the researcher. Participants were also briefed about different types of applications of wearable technologies that they may be familiar with already. Participants were then invited to complete an online questionnaire based on the validated TAM items.

Sample

The study utilised a non-probabilistic, convenience sampling method to gather participants, targeting students enrolled in the Primary Sciences Education program at the University of Palermo. It was made clear that participation was completely voluntary, and consent was gained in order to collect responses and process results. After data cleaning, the sample consisted of 596 pre-service teachers, 96.2% of the sample identified as female, whilst 3.1% identified as male, and 0.7% preferred not to disclose. Regarding the age of the participants, 86.2% were in the 18-24 age range, 10.2% in the 25-34 age range, 2.6% in the 35-44 age range, whilst the remaining were aged 45 or above.

Measures

The study employed the Technology Acceptance Model (Davis, 1989) to assess participants' perceptions of wearable technologies for anxiety and stress management in the context of teacher training. The TAM is a widely used theoretical framework for understanding how users accept and use technology, it suggests that perceived usefulness and perceived ease of use of the specific technology influence individuals' attitude towards use, which in turn affects their behavioural intentions to use said technology. Thus, these factors are purported to impact the likelihood that the technology would be adopted for actual use. Perceived usefulness focuses on how much the individual believes that the technology, in this context- wearable technologies, will improve their performance or results. Perceived ease of use refers to how much effort the person believes using the technology would be, whether it would be easy or difficult to use and learn to use. In the present study, the TAM framework was adapted to the specific context of wearables for anxiety and stress management. Responses were collected using a 7-point Likert scale ranging from strongly disagree to strongly agree. The questionnaire was split into the

TAM subsections. Perceived Usefulness (PU) included items such as “using a wearable device would help me manage my anxiety.” Perceived Ease of Use (PEOU) included items such as “I think wearable devices like Fitbits or Apple Watches would be easy to use.” Attitudes Towards Use (ATU) included items such as “I think using a wearable device to monitor stress would be a positive experience.” Behavioural Intentions (BI) included items such as “If available, I would use a wearable device to monitor my stress throughout my teaching career.” The questionnaire was structured in this way to ensure that the items reflected the theoretical constructs and structure of the TAM while being relevant to the specific context of wearable devices and technologies for stress and anxiety management in the teacher training context. The questionnaire was designed and results analysed in English but translated into Italian by a native Italian speaker in order to disseminate the questionnaire to the Italian participants.

Data Analysis

Statistical analysis was managed using Jamovi 2.2.5, utilising multiple regression to assess the predictive values of PU, PEOU, and ATU on BI to use wearable technologies for anxiety management in a teacher training context. PU, PEOU and ATU were input as the independent variables, with BI as the dependent variable. This approach enabled the study to assess the extent to which the participants’ perceptions of usefulness and ease of use impacted their attitudes, and thus behavioural intention, towards the use of wearables for anxiety management. After data collection, the raw data were prepared and cleaned, including screening for and handling of missing values. Then, before conducting the regression analysis, various assumption checks were carried out in order to affirm the reliability of the results.

Results

A multiple regression analysis was conducted to examine the extent to which the independent variables: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Attitude Toward Use (ATU) predict the dependent variable, Behavioural Intentions (BI) to adopt wearable devices for anxiety and stress management. Before interpreting the regression results, the necessary assumption checks were carried out. The plots of standardised residuals against predicted values showed no discernible or funnel patterns, supporting the assumption of homoscedasticity. Normality of residuals was examined through a Q-Q plot showing the standardised residuals against theoretical quantities; there were no substantial or sharp deviations from the line, thus confirming that residuals were normally distributed. Multicollinearity among the predictors was evaluated using the Variance Inflation Factor (VIF) and Tolerance statistics. All VIF values were below 3, and all Tolerance values were above 0.3, indicating no multicollinearity concerns. The Durbin-Watson statistic (DW = 1.96) also suggested no significant autocorrelation. As well as the assumption checks, initial relationships between variables were also examined through visual inspection of scatterplots. The scatterplots indicated that the relationships between BI and predictors ATU and PU were linear, satisfying the assumption of linearity. However, the scatterplot inspection for PEOU and BI was not showing a clear linear pattern, suggesting a potentially weak or non-linear relationship.

Regarding the regression results, the overall model was strongly significant, [$F(3, 592) = 764.00$, $p < .001$], accounting for 79.5% of the variance in BI ($R^2 = .795$, adjusted $R^2 = .794$) (full output in Table 1). The large effect size demonstrates that the TAM predictor variables

together provide a strong explanation of individuals' intentions to use wearable technologies for anxiety and stress management.

Table 1
Model Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.891	0.795	0.794	764	3	592	< . 001

Note. Models estimated using sample size of $N = 596$

Specific inspection of the individual predictors (Table 2) revealed that Attitude Toward Use (ATU) was the strongest predictor of BI ($\beta = 0.70$, $p < .001$), suggesting that more positive attitudes toward wearables were strongly associated with greater behavioural intention to use them. Perceived Usefulness (PU) was also a significant predictor ($\beta = 0.29$, $p < .001$), meaning that users who perceived the wearables as helpful and beneficial were more likely to have the intention to use them. However, reflecting the non-linear relationship revealed by the scatterplots, Perceived Ease of Use (PEOU) did not significantly predict BI when controlling for ATU and PU ($\beta = 0.05$, $p = .093$), suggesting that ease of use may not directly influence behavioural intention.

Table 2
Model Coefficients - BI

			95% Confidence Interval			
Predictor	Estimate	SE	Lower	Upper	t	p
Intercept	-0.4023	0.1508	-0.69846	-0.1061	-2.67	0.008
ATU	0.7008	0.0334	0.63511	0.7665	20.95	< .001
PEOU	0.0454	0.0269	-0.00751	0.0982	1.68	0.093
PU	0.2854	0.0352	0.21622	0.3546	8.10	< .001

However, PEOU may affect BI to use wearables indirectly through attitudes; therefore, a separate regression using ATU as the dependent variable and PEOU as the independent predictor variable was conducted. It was found that PEOU was a significant predictor of ATU ($\beta = 0.19$, $p < .001$), thus supporting the concept that PEOU is a factor to be considered for promoting positive attitudes towards the use of wearables. This was also the case when PEOU was the independent, predictor variable and PU was the dependent variable ($\beta = 0.34$, $p < .001$). These results show that while ease of use may not directly predict behavioural intention in this context, it could have indirect effects, through influencing attitudes and perceived usefulness.

Discussion

The present study sought to examine future teachers' perceptions on the use of wearable technologies for anxiety and stress management in the context of teacher training. Overall, the findings support the predictive value of the independent variables within the TAM in the context of wearable technologies. The strong model fit (R^2 = .795) indicates that TAM variables together account for a significant proportion of variance in behavioural intention to use wearable technologies for anxiety management among pre-service teachers. The findings suggest that future teachers are more likely to adopt wearable devices if they are aware of and recognise their potential benefits, holding more positive attitudes toward their use.

Attitudes Towards Use emerged as the strongest predictor of behavioural intentions to use, with a β value of 0.70. This finding highlights the central role of the evaluative judgments in promoting technology adoption decisions as proposed by Davis (1989). Looking towards the specific anxiety management context of the present study, this suggests that fostering positive attitudes towards wearables for this use, such as through workshops or demonstrations of efficacy within wellbeing management strategies, could be an important part of the curriculum for increasing adoption among teachers in training.

Perceived Usefulness was also a significant predictor of behavioural intentions to use, with a β value of 0.29, demonstrating that future teachers' beliefs about the technology's usefulness in supporting anxiety management influence their adoption intentions. The educational context may especially amplify the importance of usefulness, as teachers-in-training may perceive wearables as tools that can support their professional well-being, thus enhancing their teaching effectiveness (Burić et al., 2020).

On the other hand, Perceived Ease of Use did not directly predict behavioural intentions to use wearables, with an insignificant (p = .093) β value of 0.05, when controlling for PU and ATU. However, following analyses demonstrated significant indirect effects of PEOU on BI through its associations with ATU and PU. This indirect influence aligns with previous research that suggests that PEOU often influences behavioural intention indirectly by shaping users' attitudes (Lazim & Ismail, 2021). In the specific case of wearables for anxiety management, this implies that while ease of use alone may not directly influence behavioural intentions, workshops for future teachers that demonstrate how to use such wearable devices could enhance perceived benefits and positive attitudes, thereby indirectly encouraging adoption. The weaker direct influence of PEOU may also be related to the demographic and contextual factors. Given that the sample of pre-service teachers was generally a younger sample, it is likely that a large part of the sample was more familiar with mobile and wearable technologies already, thus the ease of use may be less considered in comparison to the technology's usefulness and their attitudes toward it. Age was also raised by Rauschnabel and Ro (2016) as an influencing factor, confirming that the age of participants is something that should be considered in more in-depth analyses of the present data when looking at factors influencing behavioural intentions to use. For the younger sample who may be more digitally confident individuals, usability may matter less than effectiveness.

In the present study's context, future educators appear to value the effectiveness and how well wearables could help manage their stress, over ease of use. These findings have several practical implications. Teacher education programs seeking to integrate wearable technologies for anxiety and stress management should not only focus on enhancing technological readiness but also work to prioritise interventions that clearly communicate the

benefits and efficacy of these devices. Demonstrating usefulness through hands-on workshops and explanations of real-world applications of wearable technologies for mental health monitoring, in order to facilitate positive user attitudes, could foster greater adoption intentions. Such positive attitudes towards use were shown to be the most important factor; thus, positive framings of such technologies are crucial for integration. Furthermore, successful integration could include providing information about how physiological data relates to emotional states and, thus, mental health well-being strategies. Curriculums could include a combined approach that also looks towards promoting positive wellbeing, offering information to the students about the value of physiological signals, and the strategies that come with being aware of these, such as breathing techniques and mindfulness.

Overall, the findings align with TAM theory, which suggests that usefulness and ease of use shape intention both directly and indirectly through influencing attitudes towards use. The dominance of attitude as the key predictor emphasises the importance of users' overall positive feelings toward wearable devices in encouraging adoption, while perceived usefulness also plays a substantial, independent role. In summary, the regression analysis supports the TAM framework by demonstrating that attitudes and perceived usefulness are significant, meaningful predictors of behavioural intention to use wearable anxiety and stress management technologies. The model's robustness was ensured through thorough assumption checks, which allow for these conclusions to provide a strong basis for future research and practical applications in technology adoption.

Limitations and Future Recommendations

The study has several limitations which should be acknowledged. Firstly, the demographic of the sample, consisting of mostly young pre-service teachers at a single Italian university, limits the generalizability of the findings. Though the results are useful for the specific context of Italian future teachers, future research should include more diverse populations across different educational and cultural settings to validate these results. Also, as mentioned in the discussion, the sample being younger could have also impacted the results, in that PEOU has been suggested to be less of a concern for more digitally competent, younger groups. Future research should consider the impact of age as well as the relationship between the level of previous experience with wearable technologies, as this may affect perceptions. Lastly, future research should thematically analyse perceptions that future teachers have regarding wearable technologies in order to capture and address any concerns and consider suggestions future teachers have regarding features and necessary training for effective implementation, thereby using a coproduction approach. Future research could also materialise the aforementioned hands-on workshops with future teachers in order to allow the students to trial the wearables.

Conclusion

The present study reinforces the applicability of Davis' (1989) Technology Acceptance Model in understanding pre-service teachers' acceptance of wearable technologies for anxiety management. Attitudes and perceived usefulness play crucial roles in shaping behavioural intentions, with perceived ease of use influencing intention indirectly. These insights contribute to a growing body of research on perceptions of the users of innovative technologies in educational contexts. The strong predictive power of both perceived usefulness and attitudes towards use suggests that if wearable technologies are shown to be beneficial for teacher wellbeing, they may be more widely accepted as useful tools.

Integrating wearable technology into teacher education programmes offers pathways to more emotionally resilient and equipped educators. As burnout and stress continue to challenge the profession, it is important to look towards strategies and personal tools for novice teachers.

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