

Unleashing the Power of Wearable Technology: Enhancing Health and Adaptation for International Students in Transition to Germany

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International students encounter many challenges while relocating to a foreign country that impacts their mental and physical well-being, creating a cumbersome adaptation process within the new academic and cultural environment. We conducted a series of participatory design sessions with 20 participants from 10 countries to understand international students' most pressing challenges during their transition to Germany and involve this population in the design process. We revealed the envisioned features of wearable technology as described by international students. Our findings indicate that the continuous accessibility characteristic of wearable technology can facilitate task management among students while also providing essential support for their well-being through monitoring physical and psychological parameters. Furthermore, integrating immersive technology with wearables emerged as a frequently requested addition, enhancing real-time connectivity and assisting students with navigation.

Additional Key Words and Phrases: HCI, Wearable technology, Health and Safety, Adaptation, Participatory design, Body storming

1 INTRODUCTION

Germany has witnessed a notable influx of international students in recent years, reaching 440,564 in 2022, representing a substantial growth rate of 37% since 2014 [4]. The transition to a new culture and academic setting can be a challenging experience for international students, impacting their physical and mental health. International students face various health challenges during their transition period, as well as language and cultural barriers, financial constraints, and a lack of knowledge about the healthcare system in their new country [11, 13]. These challenges can lead to adverse mental health outcomes and impact their well-being [10]. Moreover, over the last decade, there has been an increase in reports of mental health problems among college students in general [8]. Digital mental health tools can potentially expand the reach of mental health services for college students and offer a solution to this issue [13]. Wearable technology can be a promising solution to address these challenges by providing real-time monitoring and personalized support to international students. Wearable sensors offer information based on facts and are less likely to contain errors compared to self-reports, and it is more reliable than manually annotated data [7]. Wearables can track physiological data such as heart rate, sleep patterns, and physical activity, providing insights into the student's health and well-being [5]. Therefore, wearable technology solutions could help to address a vast scope of challenges experienced by international students during the transition period.

Through this research study, we explore how these technologies can assist students in dealing with their struggles by understanding their experiences and aiming to improve their overall well-being by answering the following questions.

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What primary challenges do international students face when they transition to Germany?

What are the critical aspects of wearable technology that hold significance for international students and have the potential to assist them in resolving their challenges effectively?

2 METHODOLOGY

To develop technology for international students, we prioritized their perspectives and feedback. We employed Participatory Design, involving users in the design process [12]. By adapting this approach, we gathered insights through interactive activities focused on the experiences of international students relocating to Germany.

Recruitment and participants

We recruited 20 participants, including 10 females, 8 males, and 2 non-binary individuals, for the study. Participants were international students studying in Germany, representing various nationalities such as India, Russia, Iran, Albania, the United States, Indonesia, Pakistan, Sri Lanka, Turkey, and Thailand. The participants took part in five two-hour design workshops, where their identities and data were kept confidential, and they consented to photography and publication.

Design activities

During the participatory design workshops, interactive activities were used to generate design ideas in written and visual formats. The workshop began with an icebreaker activity to create a comfortable environment, followed by a needs assessment where participants wrote down challenges faced during their transition to Germany. Affinity Mapping was then conducted, primarily led by participants, to categorize and cluster these challenges [6]. Participants generated ideas using How-Might-We questions (HMW) and sketched their technology concepts. They collaborated in pairs and brought their ideas to life through a Bodystorming activity. This participatory method enables collaborative problem-solving and acting within simulated real-time environments [9]. More detailed information about the design activities are presented in the appendix A. Each session resulted in two prototypes, which were discussed for their potential to address challenges faced by international students. Open discussions were held to evaluate the prototypes and identify areas for improvement. Some pictures of the prototypes are presented in the appendix B.

Data analysis

The challenges and ideas generated during the HMW exercise were analyzed, along with the transcribed presentation segment showcasing the bodystorming prototypes from the captured video data. Thematic analysis, employing inductive open coding procedures, was used to identify patterns and explore meaningful connections within the data [1]. The codes were arranged into themes using axial coding techniques[2], and a final mapping of associations between codes and themes was established. These themes are presented in the findings section of this paper.



Fig. 1. Participants during How Might We Exercise, Body Storming, Affinity Mapping (from left to right)

3 RESULTS

International students undergoing the transition phase encounter numerous challenges, as indicated in Table 1. The table highlights six main themes that encompass the most mentioned challenges. These challenges cover a wide range of dimensions and place significant pressure and responsibility on students who have recently relocated to a foreign country. The sudden need to become independent, particularly in an unfamiliar cultural setting, calls for exploring potential solutions to alleviate these circumstances. In this regard, wearable technologies emerge as a viable option for addressing these issues. Participants collaboratively brainstormed and drew from subjective experiences to develop prototypes addressing identified challenges, enriching the overall process. 1.1

Challenges	Examples
Emotional and Mental Well-being	Social anxiety, depression, isolation, etc.
Social and Cultural Adaptation	Communication struggles with locals, new culture, making friends, etc.
Language Barrier	Doctors and administrative offices mostly speak German
Physical and Environmental Challenges	Different temperatures, Winter blues, Allergies, Vitamin D
Administrative Issues	Handling your own paperwork, lot of documentation procedures
Navigating university life	Challenges in Time Management, Daily Routine, and Work-Study Balance

Table 1. Main challenges Identified by Participants

The features of wearable technology:

Continuous accessibility

One of the key findings of this research is the significant potential of wearable technology to assist international students in effectively managing the diverse range of tasks they encounter during their transitional phase. The demands associated with academic obligations, household responsibilities, and administrative tasks, compounded by their limited knowledge of available information and resources, make students uncertain about appropriate courses of action. Additionally, the language barrier further exacerbates their difficulties. Participant P3 said: "Handling your paperwork and setting up your bank account, as someone with little experience and no fluency in German, was difficult to figure out." In response to these challenges, 4 of 10 prototypes during our body-storming sessions proposed wearable technology solutions that offer task-based reminders, schedule trackers, and alerts, which emerged as valuable tools to provide much-needed support to international students, facilitating organization and efficiency in their daily lives. As one of the participants mentioned: "A wearable device, like a smartwatch tailor-made for university students, that would allow them to easily access a wide range of important information and resources they need." Furthermore, 14 participants strongly desired wearable technology to address the language barrier challenge by incorporating live translation features. Such features would prove particularly beneficial in administrative procedures and other tasks requiring interactions with local individuals or reading written materials. A specific proposal put forth by participants P6 and P8 included a real-time earbud translator to facilitate live translation, allowing users to comprehend and understand various languages audibly.

Health Monitoring

Another frequently mentioned theme emphasized the need for physical and emotional support during the transition phase. Participants described the situation "Being confronted with the gloomy winters in Germany, as a recently relocated student, I find myself wrestling with the impact on my mood and well-being."(P12) "Since I have to cook for myself now, I am struggling to figure out how to get all the vitamins I need, and I have some deficiencies now."(P16) "I was unaware how anxious I felt and how it gradually led to demotivation and depression." (P4) This trend was later seen again during presenting the ideas where 6 out of 10 presented prototypes featuring the physiological parameters tracking ability of wearables. For instance, P6, during the HMW session, suggested,

"There could be an item of clothing, like a wearable in the form of a shirt or undergarment that we can wear in long gloomy winters. This item could transfer vitamin D into our skin." or P17 said, "a Smart shirt that can be adjusted based on the weather conditions in Germany. Similarly, P13 and P15 mentioned "a ring that will collect the heart rate data or like the user's anxiety level. Moreover, upon detecting an abnormal sign from the wearer, offer suggestions." P18 and P20 stated, "wrist bands which recommend taking medicine or some foods based on our condition", or P4 noted, "A cap that reads brain nerves to understand the mental state and give feedback accordingly."

Immersiveness for real-time connectivity and navigation

Immersive technology as a requested addition to wearable technology emerged as another frequently mentioned idea, with 15 out of 40 generated ideas from participants during HMW sessions centering around its utilization and then 4 out of 10 prototypes. One aspect of these ideas aimed to establish and foster emotional connections with loved ones who are geographically distant. Participant P14 mentioned, "Immersive VR Live Streaming Experience to meet my family," as P19 said, "Holographic smart band that could help meet and interact with the family." This experience goes beyond typical communication features like video calling or instant messaging capabilities. As P1 also expressed: "Basically when we are homesick, we need to be with our loved ones, so this device exactly does that. And the best part about it is that we can experience it, not just visually see it".

Another significant aspect was addressing navigation challenges and providing information about unfamiliar places. For example, participants P9 and P11 developed a prototype of AR glasses that displayed navigational routes and furnished essential transportation information. Participants P5 and P7 envisioned "Shoes that take you to your desired places." They believed that immersive technology improves users' comprehension of their surroundings and simplifies the navigation process due to intuitive visuals and spatial cues. 1.1

4 DISCUSSION

We prioritized including international students in technology design, which fostered inclusive technology development for diverse users. Many of the wearable designs suggested by the participants aimed to address emotional challenges as students grapple with homesickness, anxiety, and uncertainty about their new environment. Although socializing has been suggested to cope with these adversities, it is essential to note that most of these solutions revolve around connecting with family members residing in the home country. This inclination is likely because family members symbolize a sense of home and offer a dependable and trustworthy support system. Furthermore, participants highlighted the lack of awareness regarding the emotional phases they may experience during the transitional period and potential hormonal or vitamin deficiencies. Consequently, these individuals desired wearable devices to track their vital signs and provide personalized predictions or recommendations to alleviate uncertainties and offer guidance. These ideas show the necessity of a wearable device with physiological data-tracking capabilities to monitor heart rate, stress levels, sleep patterns, and more. By analyzing these data points, wearable technology can provide valuable insights, early warnings, and personalized recommendations and interventions, thereby empowering students to proactively safeguard their mental and physical well-being while promoting their autonomy and self-care.

The participants in our study predominantly suggested upper-body wearables as solutions, a pattern that resonated with the research conducted by Zeagler and Gemperle [3, 14] on the ideal placement of wearables on the body. The reachability and visual feedback considerations further supported the rationale behind these choices. In future work, it would be beneficial to expand the scope of this study beyond international students in Germany and include a more diverse population. Additionally, further research could explore and incorporate a broader range of technology and interventions, going beyond the sole focus on wearable technology.

5 CONCLUSION

The challenges international students encounter during their transitional period significantly jeopardize their mental and physical well-being. Recognizing the importance of this issue, our study sought to investigate the specific challenges they encounter. By actively involving international students in our design workshops, we better understood their unique challenges. We identified essential features that wearable technologies should possess to address these challenges effectively. These features comprise specific attributes, namely, the continuous accessibility of wearable devices to facilitate efficient task management, the capability of monitoring physical and psychological parameters through wearables to provide essential health support, and the integration of immersive technology as an additional element to enhance real-time connectivity and navigation. These results emphasize the importance of international students' challenges and expand the research about wearables in the domains of mental and physical health applications as well as emotional and practical aspects of the use.

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6 APPENDIX A

Activity	Prompt/ Instruction	Time
Ice breaker	Could you please share an amusing or humorous experience you have had in Germany?	20 mins
Writing down challenges	Think of the challenges that we, as students faced during our transition period here in Germany?	10 mins
Affinity Mapping	Please group related challenges into clusters	20 mins
How Might We exercise	How might wearable technology tackle the challenges we discussed?	20 mins
Sketching ideas	Visualize how that technology might look with a rough sketch on paper	10 mins
Prototype presentation	What is good about it? What is bad about it? What can be improved? What are pros and cons?	10 mins

Table 2. Design activities procedure

7 APPENDIX B

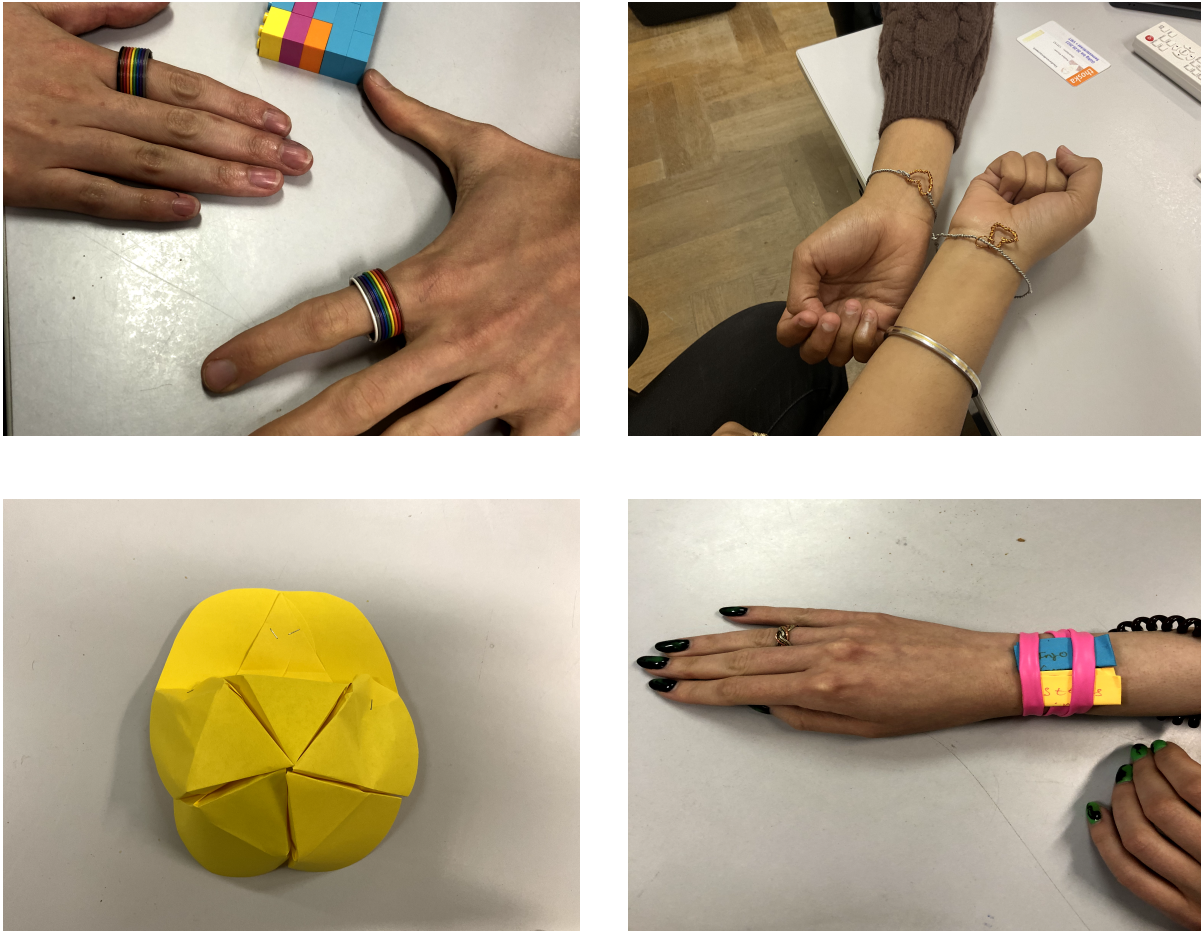


Fig. 2. Prototypes made by the participants during the body storming sessions

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