Aligning preferences: Co-Designing Wearable Solutions for International Student Well-being

NASIM AGHAMOHAMMADIAN*, Bauhaus-Universität Weimar, Germany
PANKHURI PANKHURI*, Bauhaus-Universität Weimar, Germany
MARGARITA OSIPOVA, Bauhaus-Universität Weimar, Germany
EVA HORNECKER, Bauhaus-Universität Weimar, Germany

The integration process of international students into a new culture and academic environment poses significant challenges to their physical and mental well-being. Through co-design sessions with international students, we investigated which factors international students prioritize for wearables that could support them in this context. Through the sessions, we saw a shift from addressing problems and focusing on a solution product, to a more comprehensive perspective, considering factors such as affordability, aesthetics, sustainability, placement, the importance of real-time connectivity, seamless integration into daily life, customization, and efficient power management. Our insights contribute to creating wearables that mitigate the challenges faced by international students.

CCS Concepts: • **Human-centered computing → Empirical studies in ubiquitous and mobile computing**.

Additional Key Words and Phrases: HCI, Wearable technology, Health and Safety, Participatory Design, Body Storming, Wellbeing, International Students

ACM Reference Format:
Nasim Aghamohammadian, Pankhuri Pankhuri, Margarita Osipova, and Eva Hornecker. 2023. Aligning preferences: Co-Designing Wearable Solutions for International Student Well-being. In *International Conference on Mobile and Ubiquitous Multimedia (MUM '23), December 3–6, 2023, Vienna, Austria.* ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3626705.3631793

1 INTRODUCTION

The journey of international students moving into a new culture and academic environment often presents significant challenges, impacting their physical and mental well-being. Our previous research efforts aimed to comprehend these experiences, behaviors, and the creation of solutions to cope with these challenges [8]. International students encounter various hurdles, including language barriers, cultural differences, financial constraints, and unfamiliarity with the host country's healthcare system [6, 11]. Left unaddressed, these challenges can contribute to adverse mental health outcomes, amplifying the need for accessible and effective solutions [5]. Digital mental health tools and wearable technology are promising solutions for college students' mental health [9]. Wearables offer real-time monitoring and personalized support [3]. However, features and design qualities of wearable solutions are specific to the application area and should be tailored for this. Our initial investigation uncovered aspects important for international students in Germany, namely real-time connectivity, ambience, customization, familiarity and affordability [8]. In this paper, we extend this analysis and explore how and which qualities of wearable technology participants suggested and included in their designs.

*These authors contributed equally to this research.

Manuscript submitted to ACM

2 APPROACH

For this work, we employed Co-Design with participatory methods [12], involving international students who relocated to Germany in the process. We recruited 20 participants (10 female, 8 male, 2 non-binary individuals), representing 10 different nationalities. Participants were split into five groups in two-hour workshops and engaged in interactive activities to generate design concepts in both written and visual form. The sessions began with icebreakers, followed by a needs assessment where participants documented their transition challenges in Germany in textual form. After an Affinity Mapping activity [5], primarily led by participants, they categorized these challenges. As a first design step, How-Might-We questions (HMW) [4] were used. For this, participants brainstormed ideas and graphically sketched solution ideas individually. Finally, body-storming activities brought these ideas to life, facilitating collaborative problem-solving within simulated scenarios [10]. Body storming provides a more realistic situation and environment for understanding international students' experiences in an inclusive setting, compared to traditional brainstorming or concept discussions [7]. Participants physically interact with prototypes, offering valuable insights into how the technology would function in real-life scenarios. This approach can identify usability issues, consider sensory experiences, and thus provide a holistic view of wearable technology. For data analysis, Body Storming contributed not only visual data but also added depth to our findings.

Later, the researchers examined the difficulties encountered and concepts generated in the HMW sketching activity and the video data from the sessions, including the presentation of body storming prototypes recorded on video. Thematic analysis and axial coding were used to identify recurring patterns and themes [1, 2].

3 RESULTS

During the workshops, an exciting shift in participants' priorities became evident. Initially, students concentrated on devising solutions for specific challenges in the ideation phase. However, later, especially in the final bodystorming session, their focus shifted towards evaluating practical aspects of their ideas, emphasizing functionality, technical feasibility, environmental impact, and affordability. This highlights participants' growing awareness of the need for holistic design considerations, recognizing that successful solutions must not only address problems effectively but also align with real-world constraints and sustainability concerns.

Real-Time Connectivity. It became evident that real-time connectivity had paramount importance for international students, alleviating the distress of being far from family and enabling immediate interaction. This also was a central feature of their ideas and design concepts. Seven out of 10 final concepts had an emphasis on real-time capabilities, whether a real-time connection with people (e.g., couple rings) or real-time assistance through wearables (e.g., AR glasses used for navigation).

Ambience. Another essential requirement is that wearables should seamlessly and unobtrusively integrate into students' environment and daily lives and operate in the background without requiring constant attention and interaction given the multifaceted demands and distractions faced by international students as well as co-living being the most common living condition for those. Participants P2, P3, P5, and P9 suggested that wearables should provide subtle feedback through vibration, haptic feedback, or discreet visual cues, keeping users informed without disruption.

Familiarity. Analyzing the final body storming concepts, we found that participants frequently gravitated towards familiar wearable devices in order to prevent drawing attention. For instance, P1 and P2 came up with a headset device, P5 and P6 with rings, while P13 and P14 crafted bracelets and P19 and P20 thought of AR glasses.

Preference of upper body location. From the final concepts, ten wearables were worn on the upper body. For instance, 'Sunny Side Up' is a shirt or undergarment to wear in long, gloomy winters that can transfer vitamin D to the skin. P17 suggested, "a Smart shirt that can be adjusted based on the weather conditions in Germany." Similarly, P15 mentioned "a ring designed to gather data on the wearer's heart rate and anxiety levels and, in addition, provide recommendations upon detecting any unusual indicators from the user."

Functionality, aesthetics and user interaction. When students presented their final concept, they appeared to view their ideas with a practical lens, as future products. Their discussions extended beyond a means to solve the problem, encompassing functionality, aesthetics and user interactions. These wearables were envisioned as lightweight and crafted for comfort, with a minimalist design that does not draw attention and harmoniously integrates with contemporary youth fashion choices. For example, P7 and P8 collaboratively designed pairs of bracelets with an emphasis on a visually appealing aesthetic.

Affordability. Affordability emerged as a critical concern, emphasized by P2, while sustainability was underscored by P6, highlighting students' commitment to creating socially responsible wearable technology. P16 valued efficient power management to ensure wearables can operate for extended periods without frequent charging or maintenance.

Integration with other devices. It was deemed imperative to ensure a seamless integration of wearable devices with other technological ecosystems, such as smartphones and smart home systems. This was identified as crucial for enhancing the overall user experience, seamlessly incorporating these devices into the daily routines of international students.

4 DISCUSSION AND LIMITATIONS

Customization was vital for international students, empowering them to tailor their devices to their specific needs and preferences, while also substantially reducing the learning curve associated with adopting these devices.

Regarding the choice of upper-body placement for wearable devices, this can be attributed to several pragmatic considerations. The upper body's accessibility makes it exceptionally convenient for users to engage with the device, whether it involves tactile interactions such as pressing buttons, adjusting settings, or perceiving information on the device's interface. Additionally, this placement significantly improves visibility, enabling users to monitor the device's feedback and notifications more effectively. These design choices align with prior research findings, specifically the work of Zeagler and Gemperle [3, 13], which emphasized the advantages of situating wearable devices on the upper body. Moreover, the prevalence of wearable devices, such as fitness trackers like the Fitbit, traditionally worn on the upper body, may have influenced this choice, resonating with users' familiarity and comfort with this location. Collectively, these factors underscore the practicality and user-centric rationale that underpinned the selection of upper-body placement as the optimal configuration for our wearable devices in the final prototypes.

The importance of aesthetics in wearable design should not be dismissed; rather, it represents a strategic choice that international students recognize as pivotal. Wearable devices with stylish and contemporary designs are less likely to draw unwarranted attention or judgment, a critical consideration in both social and professional settings where personal image carries significant weight. Therefore, the attention to aesthetics in design is not merely an aesthetic preference but a strategic decision in catering to the nuanced preferences and concerns of international students, enhancing the appeal and acceptance of wearable technology in various contexts.

5 CONCLUSION

Our co-design research investigates the preferences of international students in Germany when it comes to wearable technology. We observed a shift from addressing specific challenges to a more holistic perspective. Real-time connectivity emerged as a central theme, reflecting students' need to stay connected globally. The importance of wearables seamlessly integrating into daily life and environments was emphasized, highlighting the demand for unobtrusive, context-aware devices. Customization, upper-body placement, aesthetics, affordability, sustainability, and efficient power management were all recognized as vital aspects. These insights provide valuable guidance for design of wearable technology for international students, fostering a more inclusive and user-centric future for wearables..

REFERENCES

[1] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative research in psychology* 3, 2 (2006), 77–101. https://doi.org/10.1191/1478088706qp063oa

[2] Kathy Charmaz. 2006. *Constructing grounded theory: A practical guide through qualitative analysis*. sage.

[3] Francine Gemperle, Chris Kasabach, John Stivoric, Malcolm Bauer, and Richard Martin. 1998. Design for wearability. In *Second international symposium on wearable computers (cat. No. 98EX215)*. IEEE, 116–122. https://doi.org/10.1109/ISWC.1998.729537

[4] Michael Gottlieb, Emilie Wagner, Alexei Wagner, and Teresa Chan. 2017. Applying design thinking principles to curricular development in medical education. *AEM education and training* 1, 1 (2017), 21–26. https://doi.org/10.1002/aet2.10003

[5] Cyndi J Lepley. 1998. Problem-solving tools for analyzing system problems: The affinity map and the relationship diagram. *JONA: The Journal of Nursing Administration* 28, 12 (1998), 44–50.

[6] Vivian Genaro Motti. 2019. Wearable Health: Opportunities and Challenges. In *Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare* (Trento, Italy) *(PervasiveHealth'19)*. Association for Computing Machinery, New York, NY, USA, 356–359. https://doi.org/10.1145/3329189.3329226

[7] Antti Oulasvirta, Esko Kurvinen, and Tomi Kankainen. 2003. Understanding contexts by being there: case studies in bodystorming. *Personal and ubiquitous computing* 7 (2003), 125–134. https://doi.org/10.1007/s00779-003-0238-7

[8] Pankhuri Pankhuri, Nasim Aghamohammadian, and Margarita Osipova. 2023. Unleashing the Power of Wearable Technology: Enhancing Health and Adaptation for International Students in Transition to Germany. In *Mensch und Computer 2023 - Workshopband*. Gesellschaft für Informatik e.V., Bonn. https://doi.org/10.18420/muc2023-mci-src-406

[9] Koustuv Saha and Munmun De Choudhury. 2021. Assessing the Mental Health of College Students by Leveraging Social Media Data. *XRDS* 28, 1 (sep 2021), 54–58. https://doi.org/10.1145/3481834

[10] Dennis Schleicher, Peter Jones, and Oksana Kachur. 2010. Bodystorming as embodied designing. *interactions* 17, 6 (2010), 47–51. https://doi.org/10.1145/1865245.1865256

[11] Babar T Shaikh and Jean-Pierre Deschamps. 2006. Life in a university residence: issues, concerns and responses. *Education for Health* 19, 1 (2006), 43–51. https://doi.org/10.1080/13576280500534628

[12] Jesper Simonsen and Toni Robertson. 2013. *Routledge international handbook of participatory design*. Vol. 711. Routledge New York.

[13] Clint Zeagler. 2017. Where to wear it: functional, technical, and social considerations in on-body location for wearable technology 20 years of designing for wearability. In *Proceedings of the 2017 ACM International Symposium on Wearable Computers*. Association for Computing Machinery, New York, NY, USA, 150–157. https://doi.org/10.1145/3123021.3123042

APPENDICES

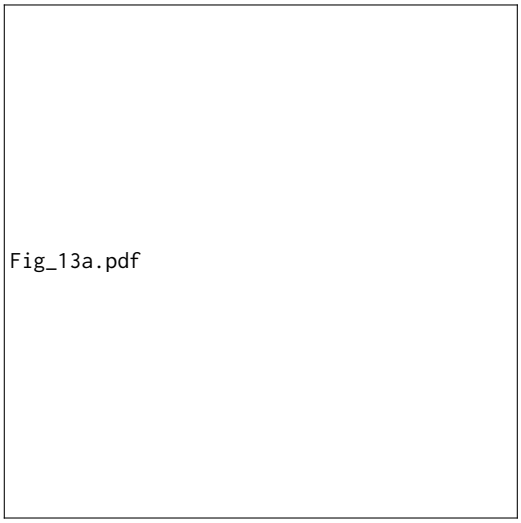
Participant	Country of origin	Gender	Age
P1	Russia	Female	22
P2	India	Male	28
P3	Thailand	Female	24
P4	Russia	Non Binary	25
P5	Iran	Female	32
P6	Russia	Female	18
P7	Turkey	Female	22
P8	India	Non Binary	28
P9	Albania	Female	24
P10	India	Male	25
P11	India	Male	26
P12	India	Male	30
P13	USA	Female	25
P14	Pakistan	Male	25
P15	India	Male	22
P16	India	Female	26
P17	India	Male	27
P18	India	Female	26
P19	Sri Lanka	Male	27
P20	Indonesia	Female	25

Table 1. Participants Demographic

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
Body storming	Please pair up and collaborate with another person to develop your ideas further and bring them to life through this activity using a set of simple materials that are provided to you (such as papers, cups, fabrics, balloons, Legos, etc.)	30 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

Fig. 1. Prototypes made by the participants during the body storming sessions



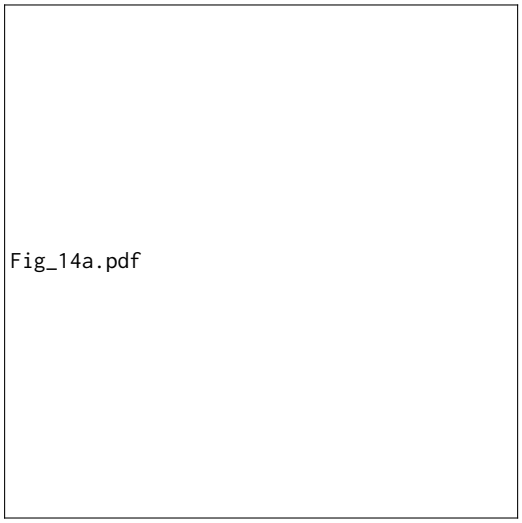


Fig. 2. Sketches made by participants during the How-Might-We session