From Methods to Mindset: Building Empathy Through User-Centered Product Development in Engineering Education D. Völz, K. Küber, T. Stender. *Gerontechnology* 25(s*)*

Purpose Physical and cognitive impairments in old age often require technical aids to support everyday life. These aids promote independence, enabling older people to remain in their familiar surroundings for as long as possible. However, many everyday products do not take physical or mental changes into account. Therefore, a more user-oriented product development is necessary, and product developers need to be made aware of this. In general, product developers find themselves caught between developing performance-tailored products and applying universal design. Methods for user-centered design (UCD) exist, but are rarely taught within mechanical engineering courses. To this end, a group of students was tasked with developing an inclusive assistive device for older people. The study, which builds upon insights from a previous systematic literature review, aims to show how the early integration of user-centered methods into engineering education can promote awareness of user needs and improve the quality of assistive technologies. **Method** An empirical study was conducted as part of the lecture course 'Applied Product Development Methodology' for Bachelor students. Two groups á five students were tasked with developing an innovative aid that would make housework easier for older people (>60 years of age). The focus was on generating product ideas, a functional structure, and a list of requirements. For the first development cycle, the students used common product development methods in accordance with VDI 2221[1] [1]. After a short introduction in UCD, in a second round, the students were tasked with developing another group's product idea using: personas, 3P point task analysis and age simulation suits [2][3]. For comparison purposes, a functional structure and a list of requirements were also developed, which were then evaluated qualitatively according to user-centered assessment criteria and quantified. Before and after the UCD process, the students completed a questionnaire based on a short scale for measuring General Self-Efficacy Short Scale-3 (GSE-3), the Saabruecker Personality Questionnaire on Empathy (SPF-IRI), a Design-Thinking Mindset questionnaire to evaluate Human-Centeredness, and additional Likert-scale and open questions, to assess the effectiveness and empathy for the target group [4][5][6]. No formal ethics approval was required; all data were collected anonymously within a university teaching context in compliance with GDPR[2]. **Results and Discussion** The qualitative evaluation offers greater added value than the quantitative evaluation, as the results are less statistically significant due to the small number of participants. Nevertheless, the results demonstrate a trend that suggests that UCD methods promote empathy for potential users and that the students found the approach to developing products for the target group helpful. A comparison of the functional structures of the two test runs reveals a high degree of similarity. The application of UCD methods in the development process generates lists of requirements that are characterized by enhanced precision and a greater degree of orientation towards the needs of the target group. By donning age simulation suits, for instance, the students were able to empathize with the target demographic at an early stage and more accurately evaluate the dimensions reflected in the list of requirements. A higher level of age appropriateness is evident in the products when the product ideas are evaluated based on general user-centered requirements. The development of empathy among product developers is a key component of good products. The utilization of age simulation suits, alternative methodologies such as direct contact with users, user observation, or immersive interaction experience rooms, which can be integrated with storyboards and/or role-playing, can be employed to maintain empathy. The insights and structures derived from this study can be utilized to develop an approach for product developers employing mixed reality to foster greater empathy toward elderly users in the product development process. Furthermore, this work establishes a foundation for integrating UCD approaches into future mechanical engineering academic curricula and for evaluating their effectiveness through systematic questionnaire-based assessments. This study underscores the significance of methodologies employed in fostering empathy and offers recommendations for the systematic integration of such methodologies within the area of responsibility of engineering.

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[1] VDI is an Association of German Engineers I [2] 3P: Person, Place, Process I [3] GDPR: General Data Protection Regulation

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