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D2.1 COMPREHENSIVE REPORT ON THE FOCUS GROUP RESULTS

April, 2025

University of Oulu

ABSTRACT

This deliverable presents comprehensive results from focus groups conducted across three European universities (Malta, Pisa, Oulu) as part of the EDUWEAR project. Twenty-eight health sciences and engineering educators discussed engineering curriculum gaps for custom wearable medical devices. Thematic analysis identified project methodology, prerequisites, course design, opportunities/outcomes, and critical gaps. Key findings show gaps in systems integration, technical specialization, interdisciplinary collaboration, and human-centric design. These insights were used to create a comprehensive survey for students and professionals to validate gaps. Transdisciplinary approaches in assistive technology development are emphasised in the study, highlighting educational gaps and industry needs. The survey results will be analysed in a later deliverable (D2.2), keeping the current document focused on focus group results.

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EXECUTIVE SUMMARY

The EDUWEAR project deliverable D2.1 presents a comprehensive analysis of competency gaps in engineering education for the design of customisable wearable medical devices. This research forms the initial part of the project aimed at developing interdisciplinary educational approaches that bridge engineering and health sciences.

The study employed a two-phase methodology beginning with focus groups conducted across three European partner universities: University of Malta, University of Pisa, and University of Oulu. Twenty-eight educators representing diverse expertise, including orthotics and prosthetics, occupational therapy, mechanical engineering, physiotherapy, industrial design, electronics engineering, and digital healthcare participated in structured discussions to identify educational gaps and requirements.

Through systematic thematic analysis, five primary themes emerged: project methodology, prerequisites, course design, opportunities/outcomes, and competency gaps. The analysis revealed significant deficiencies in current engineering curricula, particularly in systems integration knowledge, where students struggle to connect theoretical concepts with practical implementation. Key gaps identified include limited understanding of component interactions within complex rehabilitation engineering projects, insufficient exposure to specialised technical areas such as design for manufacturing and materials selection, and underdeveloped data analysis and computational skills.

Beyond technical competencies, the study highlighted critical gaps in interdisciplinary collaboration, human-centric design principles, information security considerations, and user experience (UX) development. These findings emphasise the disconnect between current academic preparation and industry requirements for developing rehabilitation technologies.

Building on focus group insights, researchers developed and administered the EDUWEAR Survey to engineering and health science students and professionals across Malta, Italy, and Finland. The survey utilised the DigiClap case study—a customisable wearable device for children with cerebral palsy—to contextualise questions about competency requirements.

The findings strongly support transdisciplinary educational approaches that integrate diverse knowledge domains and methodologies. This provides foundational evidence for developing comprehensive curricula that better prepare students for collaborative work in assistive technology development, supporting more effective rehabilitation solutions.

1. INTRODUCTION

The focus groups were conducted with educators from the University of Malta, the University of Pisa, and the University of Oulu as part of a three-stage methodology. We used a qualitative research approach in analysing the results of focus groups; through thematic analysis, we identified five main themes: (i) project methodology, (ii) prerequisites, (iii) course design, (iv) opportunities/outcomes, and (v) competence gaps. The findings reveal significant deficiencies in specific technical skills, including practical application of industry-standard software, systems integration knowledge, and computational abilities. Additionally, we observed substantial gaps in interdisciplinary collaboration and interprofessional knowledge transfer capabilities among engineering students. These results highlight the disconnect between current engineering curricula and industry requirements, particularly in preparing students for the complex, multidisciplinary challenges of designing customisable wearable medical devices. The primary aim of this deliverable (D2.1) is to present the outcomes of these focus groups and explain how they informed the development of a questionnaire. Using the focus group findings, the questionnaire was designed to gather further insights from engineering and health science students and professionals. The comprehensive analysis of the survey results will be reported in Deliverable D2.2, ensuring that the current document remains focused on the qualitative findings and survey design.

1.1. Objectives

The main objective behind this deliverable is:

- To identify gaps in competencies required for engineering education in wearable device development.

1.2. Scope

The scope of the focus group was limited to educators, students, and Professionals from Health sciences and engineering disciplines. Initially, the focus group's scope was limited to educators from the three European universities mentioned before. Later a questionnaire was developed aiming to gain the response of students and professionals for Health sciences and engineering disciplines on competency gaps in engineering curriculum for design of customisable wearable medical devices.

1.3. Terminology

Term	Meaning
DigiClap	Project case-study device by the University of Malta used as an example of a wearable rehabilitation device for the purposes of surveys in the EDUWEAR project
GDPR	General Data Protection Regulation
IPE	Interprofessional Education
HCI	Human–Computer Interaction
UX	User Experience
TA	Thematic analysis (a type of qualitative research methodology)

2. METHODOLOGY

2.1. Focus Group Approach

The approach is based on three stages, each of which is discussed below.

- **Stage 1:** Initially, focus groups involving educators from three European countries are conducted to gather insights into existing educational practices and identify potential areas for improvement, which is this study's focus
- **Stage 2:** The findings from these focus group discussions inform the subsequent stage, which involves survey from the respective regions. Based on the results of Stage 1, comprehensive questions for group survey with students and professionals are developed.
- **Stage 3:** In this final Stage, comprehensive data analysis and gap identification are performed. This approach ensures a holistic understanding of the educational landscape from both teaching and learning perspectives. The data collected through these stages is meticulously analysed to pinpoint specific competence gaps within product and design engineering curricula.

Figure 1 shows the methodology based on the three stages discussed above.

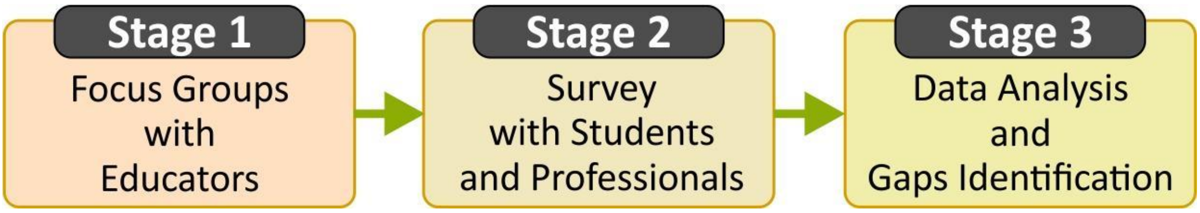

Figure 1. Situating the deliverable D2.1 study at Stage 1 of the overall three-stage methodology

The methodology employs qualitative research methods across three stages presented in Figure 1. To achieve the objective stated in Section 1.1, we introduced the group to the DigiClap case study (Bonello et al., 2024), a smart wearable rehabilitation device designed for children, to provide context for the subsequent survey discussions. Following that, the focus group is prompted by the questions of participants' opinions of the competence gaps in the manufacturing of customisable wearable devices and participants' thinking about the curriculum needs to include with regards to developing customisable medical devices for rehabilitation. Several probing questions are provided to facilitate further discussion, covering topics of challenges, principles, requirements, and opinions. At the end, the activity is concluded with the group identifying key gaps

- **Number of sessions:** Three sessions were conducted with educators, including one in each partner university. The number of participants in each session is listed in Table 1
- **Participant selection:** The selection process was guided by the principles of diverse expertise and the inclusion of all participating partners.

- **F acilitation method:** Initially, a presentation was given to the participants, after which discussion was facilitated using probing questions.
- **Duration:** Each session lasted around one hour and ten minutes.

Table 1 presents the place and number of participants in each focus group session and the expertise of the participants.

Table 1. Characteristics of the three focus groups

Place (Participants)	Participants expertise
University of Malta (9)	Orthotics and Prosthetics, Occupational Therapy, Assistive Technology, Hand Therapy, Electrical & Mechanical Engineering, and Interprofessional Education
University of Pisa (9)	Mechanical Engineering, Physiotherapy, Industrial Design
University of Pisa (10)	Design Science, Design Education, Electronics Engineering, HCI, Software Development, Digital Fabrication, Digital Healthcare, Nursing Education

Figures 2, 3 and 4 illustrate the actual focus groups at the sites of University of Malta, University of Pisa and University of Pisa, respectively.

Figure 2. Focus group at the University of Malta

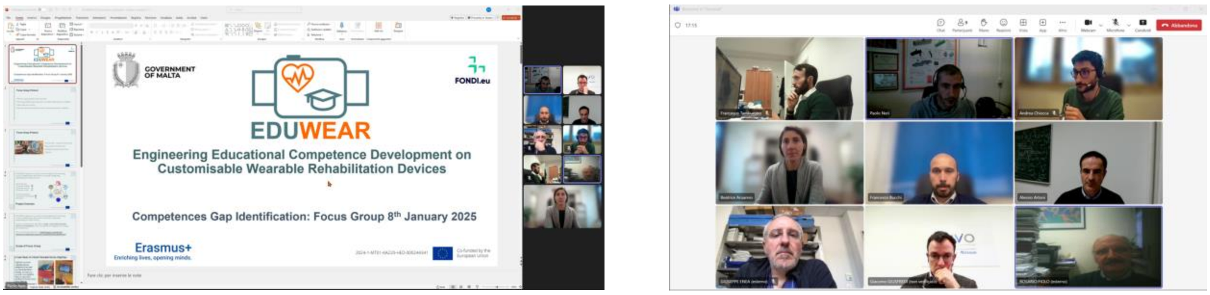

Figure 3. Focus group at the University of Pisa

Figure 4. Focus group at the University of Oulu

2.2. Data Analysis

- **Data Analysis:** Thematic analysis (TA) was used for data analysis since it is a widely used qualitative research method for identifying, analysing, and interpreting patterns of meaning within data (Braun and Clarke, 2006). It is applied to the focus group outcomes. TA offers flexibility in approaching research patterns and can be applied across various theoretical frameworks and research paradigms (Braun and Clarke, 2006). In this study, we utilise TA to comprehensively report the results of the focus groups.

- **Survey Method:** The questionnaire was developed based on focus group insights and administered to engineering and health science students in each partner university and professionals in the above disciplines. The survey is attached to this document as Appendix A and was distributed through online forms, followed by a presentation that introduced the questions and topics. The comprehensive analysis of the survey results will be reported in Deliverable D2.2. Table 2 presents the number of participants' responses (Students and professionals) from each partner university.

Table 2. Survey responses

Place	Number of responses (Language)
Students from the University of Malta	31 (English)
Students from the University of Pisa	16 (English)
Students from the University of Oulu	12 (English), 8 (Finnish)
Professionals working in Malta, Italy, and Finland	5/5/7 (English), 5 (Finnish)

3. Results

3.1 Focus Group Results

The thematic analysis finds five main categories. These are project methodology, pre-requisites, project course, opportunities/outcomes, and gaps in engineering curriculum (Figure 5).

- **Theme 1:** The first theme concerns general project methodology. It further emphasises the structured and methodological approach of the project. Moreover, it is also presented in the results that the practice of data collection from several geographical locations, institutions, professions, and work cultures can enhance the credibility of outcomes. While such diversification of data collection and analysis enhances the credibility of results, it also requires streamlining of terminologies used in different professions (such as healthcare and engineering) and in different cultural contexts.
- **Theme 2:** The second theme includes prerequisites and addresses the foundational knowledge, skills, and attitudes students need before engaging with advanced engineering coursework. This includes technical fundamentals, mathematical proficiency, spatial reasoning abilities, use-related knowledge, and baseline digital literacy that are essential for successful engineering education. Moreover, some fundamental aseptic knowledge, including hygiene requirements related to the use of wearable devices, considering skin conditions and sensitivity of the individual using the device, while selecting the material for the device development. Hence, it requires foundational knowledge of basic material properties used in several manufacturing technologies.
- **Theme 3:** The third theme focuses on the course and examines the actual educational content and delivery methods, encompassing curriculum structure, teaching approaches, assessment strategies, and the balance between theoretical knowledge and practical application in engineering programs. Learning by doing, using an open-

ended prototyping approach, Interprofessional Education (IPE), and case-study methods were suggested by the experts as a teaching methodology for the curriculum. This is due to the multidisciplinary nature of the course content. Furthermore, some other practice approaches, such as joint supervision and clinical observation, were also suggested by the experts as part of the teaching plan in such a curriculum.

- **Theme 4:** The fourth theme outlines opportunities and outcomes, focusing on the potential benefits and results of engineering education, including career pathways, professional development possibilities, and the broader impacts that well-designed curricula can have on students' future success and industry readiness. However, some associated challenges were also highlighted, such as the cost-effectiveness of wearable device development, aesthetic aspects of the device, assessment of the wearable device at the development stage, and consideration of the sensitivity of individuals using the device. Such challenges can be addressed on a case-by-case basis and by including general guidelines in the curriculum.
- **Theme 5:** The fifth final theme points out the gaps and identifies the disconnects between current educational offerings and industry requirements, highlighting areas where engineering curricula fall short in preparing students for professional practice. This includes missing technical competencies, underdeveloped soft skills, limited exposure to emerging technologies, and insufficient integration of interdisciplinary perspectives. Apart from the competence gaps mentioned above, other gaps related to the design of smart wearable devices were also identified, such as information security, human-centric design, and the user experience of wearable devices. Where information security encompasses issues related to data management collected through the device, the accuracy, reliability, and anonymity of the data can also be key considerations in curriculum development. While the competence gap related to human-centric design and user experience is related to the topics of developing user guidelines of the devices to be provided to the users, leading to enhance user experience. The design of the device is tailored to consider the comfort and algorithmic requirements and preferences of the user. Considering such factors in curriculum design can provide a well-rounded experience for students.

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Project

1 Project Methodology
- Refine research questions
- Clarify terminology
- 3 sites implementation boosts credibility

2 Pre-requisites

Manufacturing
- Theory
- Process

Design
- Techniques
- Tools
- Methods
- Domain knowledge

Technologies
- VR/AR
- Machine learning and AI
- Motion capture
- 3D printing
- Polimeric materials
- 3D scanning
- Sensors
- Selection/integration of electronic hardware
- Mechatronics
- Signal processing
- Programming

Foundations of medical/ health subjects
- Anatomy
- Kinesiology
- Ergonomics
- Basic neurology
- Mechanical properties of human body
- Client-centred approach
- Impact of impairment on design/engineering
- Impact of digital and other technologies on designing for disability
- Disability studies
- Interdisciplinary collaboration

Aseptic knowledge
- Hygiene and washing of devices
- Individual, disposable or used repeatedly
- Durable and washable materials
- Skin condition and sensitivity

3 Project Course

Course length
- Longer

Course level
- Add-on/elective to undergraduate
- Specialisation – taster for future Masters course

Course content
- Topics from both engineering & health sci.
- Learn about other prof.
- Design for health sector
  - *Medical*
  - *Rehabilitation technology*
  - *Universal Design approach*
- Application of pre-requisite subjects to wearable devices
- Compliance with international standards
- Principles of biomechanics
- Customisability vs mass production
- Hard and soft skills
- Co-production

Knowledge of diseases
- Visual impairment
- Epilepsy
- Neurological patients
- Hearing impairment
- Mobility impairment
- Short stature

Device durability
- Know what to do
- Place and time to fix
- Intended use and potential risks at design stage
- Guidance in case of problems
- Replacement parts

Course lecturers
- Interdisciplinarity - range of expertise needed

Pedagogical methods
- Learning by doing
- Evidence-based
- Interprofessional education (IPE)
- Theory/knowledge
- Case studies
- Discussions
- Observations in clinic
- Joint supervision
- Common practical assignments
- Hands on workshops

4 Opportunities/ Outcomes

Look at good practice examples
- MA in orthotics and prosthetics
- ACTU
- Year-long study-unit in design

Develop into a Masters course e.g. Assistive technology Design and Manufacturing
- e.g. core subjects taught to students from both fields together, then include streams of specialisation

Involve ICT expertise

Appreciation/Awareness
- Specialisation opportunities for students
- Creating contacts for life, networking
  - *Learning to understand each other and work together*
  - *Whom to reach out to for other expertise*
- New technologies bringing together different fields of expertise/practice
- Project will be giving students what they would otherwise have to learn on their own
- Train the trainers/ lecturers in IPE

Associated challenges
- Cost-effectiveness
  - Sufficient to measure the condition
  - Resources allocation
  - Assessed at design stage

Commerciality
  - Brand status
  - Commercialization and status building
  - Top athletes as branders
- The most discreet devices possible
  - Should not look different, e.g. braces

Recommendation for future
  - Identification of competences
  - Building on previous experience
  - Multidisciplinary and cooperation

5 Gaps in Engineering Curriculum

Interdisciplinarity
- Need for a common 'language'
- Specific Terminology
- Awareness re different professionals' roles
- More opportunities to meet, work, learn together
- Engineers and healthcare professionals collaborate in practical settings
- Barriers to ID: territorialism, identity issues

Specific Engineering topics missing
- Electronics – bluetooth, mobile apps, development of software interf.
- Industry and process of development up to marketing stage
- Regulations & standards
- Compliance Issues
- Control Systems
- Testing environments/ conditions

IT-related gaps for design device interfaces

Information Security
- Data management
- Measurement accuracy
- Value addition
- Evaluation skills
- Critical analysis
- Reliable measurement
- Data leakage
- Anonymous data

Application knowledge
- Easily used
- Durable, upgradeable

Identifying the care need
- Planning rehabilitation
- Device necessity
- Value addition/impact
- Device validation protocols

Foundations of health/ medical subjects (how the body works, how it malfunctions)

Issues around disabilities /chronic Illnesses

Service-user involvement from design to manufacturing/co-production/ collaborative practice/ user-centred approach/ lived experience/experts by experience

Functionality (purpose)

Ergonomics (weight)
- Professional/clinician input
- Foundations in ICT topics

Design related competence
- Personalized/comfortable
- A user-centered approach
- On skin or clothing

Guiding the user
- Guidance source
- Disease knowledge
- Instruction confusion
- Team involvement
- Awareness influence
- Usability focus
- Patient-specific guidance

Figure 5. Identified themes in the thematic analysis

3.2 Survey

Survey results will be comprehensively analysed in the deliverable D2.2. Appendix A provides a full survey in printed form. The actual survey is delivered using Google Forms from the Google for Education account of the University of Oulu.

3.1. Interpretation and Implications of Results from the Focus Groups

3.1.1. Lacunae in Specific Technical Skills

The thematic analysis suggests several lacunae in technical skills across engineering education. Within the gaps in the engineering curriculum theme, notable shortcomings are identified in students' practical application abilities, particularly in using industry-standard software tools and platforms. Students lack sufficient experience with CAD software, simulation tools, and manufacturing technologies that are commonly used in professional settings.

The analysis also points to deficiencies on a meta-level, for example, in systems integration knowledge, where students struggle to connect theoretical concepts with practical implementation. This includes limitations in understanding how different components and subsystems interact within complex engineering projects in a rehabilitation context. Additionally, there are gaps in specialised technical areas such as design for manufacturing, materials selection, and advanced prototyping techniques that are essential for product development. This supports the observation that transdisciplinary approaches to assistive technologies can lead to innovative and transformative solutions by integrating different knowledge and methods (Boger et al., 2017). A hands-on, transdisciplinary approach (Lundy et al., 2018) aligns with the observation that integrating diverse knowledge and methods can lead to innovative solutions in the development of assistive technology.

Another significant technical gap concerns data analysis and computational skills. These themes suggested that students often graduate with inadequate abilities in programming, algorithm development, and applying computational methods to solve engineering problems. The themes suggest that while theoretical knowledge may be present, the practical technical competencies needed to execute projects effectively in real-world contexts are often underdeveloped, creating a disconnect between academic preparation and industry requirements.

3.1.2. Interdisciplinary Collaboration and Interprofessional Knowledge Transfer

Overall, there is also a significant need for interprofessional knowledge transfer. The analysis reveals a significant gap in students' ability to work effectively across disciplinary boundaries. Engineering students need more structured opportunities to collaborate with peers from other fields, such as business, design, and health/social sciences, to develop a holistic understanding of product development challenges. There is also a need for improved communication skills specifically tailored to interdisciplinary collaboration contexts, where technical concepts must be translated for non-technical stakeholders. Similar translation requirements are valid for concepts of different domains. Previously, a cross-domain translation of concepts has been required for such courses, with engineers explaining technical modifications to non-technical audiences and therapy students teaching engineers to contextualise designs within rehabilitation frameworks (Lundy et al., 2016). This aligns closely with the identified need. These observations highlight the importance of integrating interdisciplinary learning experiences into engineering education, enabling students to collaborate effectively across different fields and apply diverse perspectives in their design processes.

3.2. Survey Design and Implementation

The survey, titled "EDUWEAR Survey," was developed based on the insights gained from the focus groups to further validate and expand upon the identified competency gaps. The questionnaire was carefully structured to collect comprehensive data from both engineering and health science students, as well as professionals working in these fields across Malta, Italy, and Finland. Primary objectives are

- Validate the competency gaps identified in the focus group discussions
- Gather quantitative data on the perceived importance of various skills and knowledge areas
- Assess the current level of interdisciplinary awareness among students and professionals
- Identify preferred teaching and learning methods for developing the required competencies
- Understand barriers to effective collaboration between engineers and healthcare professionals

5.1 Survey Structure and Content

The questionnaire was organised into four main sections:

Section 1: Demographics: This section collected basic information about respondents, including age, gender, nationality, educational background, and professional experience. For students, information about their course of study and year was collected, while professionals were asked about their years of experience and current position.

Section 2: Background Questions: This section explored respondents' previous exposure to interdisciplinary education and collaborative work environments. Questions assessed whether participants had experience with shared courses involving students from other degree programs, interactions with lecturers from different faculties, and awareness of who should be involved in designing rehabilitation technologies.

Specific Questions: This comprehensive section formed the core of the survey, using Likert scales (1-5) to measure:

- Familiarity with key concepts like User-Centred Design, Universal Design, and Collaborative Working
- Perceived importance of various factors in developing customisable wearable rehabilitation devices
- Awareness of specific knowledge areas (e.g., human anatomy, data privacy, international standards)
- Attitudes toward interdisciplinary collaboration

- Confidence in communicating across disciplinary boundaries

Section 3: Concluding Questions: The final section assessed respondents' overall preparedness for working in the development of customisable wearable rehabilitation devices and gathered preferences for teaching and learning methods that would best support the development of the required competencies.

5.2 Survey Administration and Data Analysis Approach

The questionnaire was distributed through online forms to students from the three partner universities (Malta, Pisa, and Oulu) and to professionals working in these regions. Prior to survey completion, participants attended a brief presentation that introduced the EDUWEAR project, the DigiClap case study, and explained the purpose of the questionnaire. Ethical considerations were addressed through a comprehensive consent form compliant with GDPR regulations. Responses were collected from the different stakeholder groups as shown in Table 2.

Survey data was analysed using a mixed-methods approach. Quantitative analysis of Likert-scale responses (1-5) utilised descriptive statistics and comparative analysis between demographic groups. Qualitative analysis examined open-ended responses and justifications to identify underlying themes. The survey results were then integrated with focus group findings to validate the identified competency gaps and inform the comprehensive gap identification in Stage 3 of the methodology. This approach ensured that both educator perspectives (from focus groups) and student/professional perspectives (from surveys) contributed to the final analysis.

4. Conclusion

To achieve the objective of identifying gaps in competencies required for engineering education in wearable device development, three focus groups were conducted at partner universities, involving 28 educators and experts. The discussions were guided by probing questions, and the responses were recorded and later analysed using thematic analysis. This process led to the identification of five key themes: prerequisites, project courses, gaps in the engineering curriculum in relation to the objective, as well as the challenges and opportunities associated with the project. The findings were then presented accordingly.

Overall, the results of focus groups present a novel approach to addressing competence gaps in product and design engineering curricula, focusing on the development of smart wearable rehabilitation devices. The study employs a three-stage qualitative methodology to identify educational gaps and emphasises the importance of integrating interprofessional knowledge transfer and human-centred design principles into engineering education.

The results of focus groups highlight the need for a more interdisciplinary approach combining technical and health sciences-related expertise with an understanding of user needs. The expected outcomes shall provide holistic insights into how to equip educators, students, industry professionals, medical experts, and end-users with the knowledge to develop more effective, empathetic, and innovative rehabilitation solutions. As we move towards a future where personalised and adaptive technologies become increasingly prevalent, equipping students with these skills will be crucial in driving innovation and ensuring that engineering solutions are truly centred around human needs.

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6. Appendix A

EDUWEAR Survey

The EDUWEAR course aims to equip learners with the skills needed to develop customisable wearable devices for rehabilitation. This survey will help us identify the key requirements for designing an introductory course on the fundamental principles behind creating such devices.

This consent form specifies the terms of my participation in this research study.

1. I have been given written and/or verbal information about the purpose of the study; I have had the opportunity to ask questions and any questions that I had were answered fully and to my satisfaction.

2. I also understand that I am free to accept to participate, or to refuse or stop participation at any time without giving any reason and without any penalty. Should I choose to participate, I may choose to decline to answer any questions asked. In the event that I choose to withdraw from the study, any data collected from me will be erased as long as this is technically possible (for example, before it is anonymised or published), unless erasure of data would render impossible or seriously impair achievement of the research objectives, in which case it shall be retained in an anonymised form.

3. I understand that I have been invited to participate in a survey in which the researcher will investigate the gaps in competencies required for engineering education in wearable device development.

4. EDUWEAR's objective is to create an interdisciplinary EU e-learning course, complemented with hands-on exercises, integrating engineering and health sciences. It aims to equip learners with skills to design customisable wearable devices for rehabilitation, which necessitates the integration of a range of competencies. The program emphasises case studies and provides guidance to enhance knowledge transfer on such products, fostering collaboration between engineers and healthcare professionals.

5. I am aware that the survey will be 30-45 minutes long and will take place at a place and time as convenient for me.

6. I understand that the activities listed above will be conducted in a place and at a time that is convenient for me.

7. I understand that my participation does not entail any known or anticipated risks.

8. I understand that there are no direct benefits to me from participating in this study. I also understand that this research may benefit others by providing my feedback and/or get my capabilities assessed.

9. I understand that, under the General Data Protection Regulation (GDPR) and national legislation, I have the right to access, rectify, and where applicable, ask for the data concerning me to be erased.

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10. I have been provided with a copy of the information letter and understand that I will also be given a copy of this consent form.

11. I am aware that the survey may be held online; in such case, the researcher will use Zoom.

12. I am aware that, by marking the first tick-box below, I am giving my consent for the identity of the organisation I represent to be revealed in publications, reports or presentations arising from this research, and responses I provide may be quoted directly or indirectly

☐ I agree that my identity/the identity of the organisation I represent may be disclosed in research outputs

☐ I do not agree that my identity/the identity of the organisation I represent may be disclosed in research outputs.

13. I am aware that my data will be pseudonymised; i.e., my identity will not be noted on transcripts or notes from my interview, but instead, a code will be assigned. My profession e.g. engineer, educator or OT, shall be disclosed as deemed necessary. The codes that link my data to my identity will be stored securely and separately from the data. Raw identifiable data will be encrypted and stored offline on an external hard drive or flash drive, or a secure UOO server (not the UOO Google Drive). Any material in hard copy form will be placed in a locked cupboard. Only the research team will have access to this data.

14. I understand that all data collected will be stored in an anonymised form until the analysis is complete and the research publications associated with the respective studies are finalised.

15. I am aware that my identity and personal information will not be revealed in any publications, reports or presentations arising from this research

☐ I have read the above

Demographics

2.1 Age *

2.2. Gender *

☐	Female
☐	Male

☐	Prefer not to say
☐	Other: ______

2.3. Nationality *

______

2.4. For students: *

Course of study (please use the format of "Bachelor of [Type] in [Major]", like Bachelor of Science in Computer Science)

______

2.5. For students: *
Year of the course

______

2.6. For professionals: *
Years of experience (professional/academic)

______

2.7. For professionals: *
Academic/industry position

______

2.8. For professionals: : *

Education Background (please use the format of "Bachelor of [Type] in [Major]", like Bachelor of Science in Computer Science)

______

A Case Study of a Customisable Wearable Rehabilitation Device (DigiClap)

DigiClap is a customisable wearable device designed to be used during rehabilitation therapy, primarily by children with Cerebral Palsy to help them develop functional hand skills, offering occupational therapists a novel mean to conduct their session

DigiClap

DigiClap Features

Background Questions

4.1. Did you have any shared courses with students from other degree programs? *

☐ Yes

☐ No

4.2. If yes, which faculties did they come from?

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4.3 Were you ever taught by lecturers other than engineers? *

☐ Yes

☐ No

4.4. If yes, which faculties did they come from?

4.5. Do you know who should be involved in the design and manufacture of technologies for rehabilitation? *

☐ Yes

☐ No

4.6. If yes, which faculties did they come from?

4.7. Do you ever find yourself having to find knowledge on your own (that is not in the curriculum)? *

☐ Yes

☐ No

4.8. Explain what type of knowledge you look for:

Specific Questions

5.1. On a scale of 1 (Least) to 5 (Most), how familiar are you with the following terms in your context as an Engineering student or Engineer)? *

	1	2	3	4	5
User-Centred Design	☐	☐	☐	☐	☐
Universal Design (UD)	☐	☐	☐	☐	☐
Collaborative Working	☐	☐	☐	☐	☐
Co-production	☐	☐	☐	☐	☐
Hard Skills	☐	☐	☐	☐	☐
Soft Skills	☐	☐	☐	☐	☐

5.2. On a scale of 1 (Least) to 5 (Most), rate the importance of the following items when developing customisable wearable rehabilitation devices (e.g. DigiClap):

	1	2	3	4	5
User-Centred Design	☐	☐	☐	☐	☐
Universal Design (UD)	☐	☐	☐	☐	☐
Collaborative Working	☐	☐	☐	☐	☐
Co-production	☐	☐	☐	☐	☐
Hard Skills	☐	☐	☐	☐	☐
Soft Skills	☐	☐	☐	☐	☐

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5.3. Justify your answer?

5.4. On the scale of 1 (Strongly Disagree) to 5 (Strongly Agree), when developing such devices, you think it is important to: *

	1	2	3	4	5
Work with other professionals	☐	☐	☐	☐	☐
Observe patients in the clinic)	☐	☐	☐	☐	☐

5.5. Justify your answer? *

5.6. How aware are you on a scale of 1 (Least) to 5 (Most) of the following when designing customisable wearable devices for rehabilitation? *

	1	2	3	4	5
Available measurement techniques for the human body	☐	☐	☐	☐	☐
Mechanical properties of relevant materials in this field (e.g., human body tissues and bio-compatible materials)	☐	☐	☐	☐	☐
Electronic devices available for human data monitoring	☐	☐	☐	☐	☐

International standards regulating human-machine interaction	☐	☐	☐	☐	☐
Biomechanics principles	☐	☐	☐	☐	☐
Verification, validation and testing plans (e.g., standards related to mechanical testing, usability studies)	☐	☐	☐	☐	☐

5.7. How important on a scale of 1 (Least) to 5 (Most) do you think having knowledge on the following is, when designing customisable wearable devices for rehabilitation?

	1	2	3	4	5
Basic human anatomy	☐	☐	☐	☐	☐
Function/dysfunction of the human body	☐	☐	☐	☐	☐
Modularity	☐	☐	☐	☐	☐
Co-production	☐	☐	☐	☐	☐
Customisation (user-controlled) vs. personalisation (system-controlled and adaptive)	☐	☐	☐	☐	☐
Uniform terminology between engineers and healthcare professionals	☐	☐	☐	☐	☐
Working in a multidisciplinary team in the design process	☐	☐	☐	☐	☐
Consideration of data privacy and security issues	☐	☐	☐	☐	☐
Critical thinking and combining knowledge/ research data from different sources and implementation	☐	☐	☐	☐	☐
Knowledge about guiding the user to utilise the device	☐	☐	☐	☐	☐
Involving user groups in the design process	☐	☐	☐	☐	☐
Electronic devices available for human data monitoring	☐	☐	☐	☐	☐
International standards regulating human-machine interaction	☐	☐	☐	☐	☐
Available measurement techniques for the human body	☐	☐	☐	☐	☐
Mechanical properties of relevant materials in this field (e.g., human body tissues and bio-compatible materials)	☐	☐	☐	☐	☐

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Prevention of skin irritation and allergic reactions	☐	☐	☐	☐	☐
Hygiene and cleaning procedures for reusable devices	☐	☐	☐	☐	☐
Psychological impact of having to wear a device for rehabilitation	☐	☐	☐	☐	☐
Design for different age groups (children, adults, elderly)	☐	☐	☐	☐	☐

5.8. On a scale of 1 (Least) to 5 (Most) how important do you consider the following aspects when designing rehabilitation wearable devices? *

	1	2	3	4	5
Cost-effectiveness	☐	☐	☐	☐	☐
User adoption strategies	☐	☐	☐	☐	☐
Device discretion/invisibility	☐	☐	☐	☐	☐
User pride in device (making it a desirable accessory)	☐	☐	☐	☐	☐

5.9. What do you perceive as the main barriers to effective collaboration between engineers and healthcare professionals? (Select all that apply)

☐ Different terminology/language

☐ Different priorities

☐ Lack of understanding of each other's roles

☐ Territorial issues

☐ Professional identity concerns

☐ Other:

5.10 Rate your agreement with the following statements on the scale of 1 (Strongly Disagree) to 5 (Strongly Agree): *

	1	2	3	4	5
I feel confident communicating my engineering expertise to non-engineers	☐	☐	☐	☐	☐
I know when to refer to healthcare expertise in design decisions	☐	☐	☐	☐	☐
I can translate technical specifications into language accessible to non-engineers	☐	☐	☐	☐	☐

5.11 How do you envisage that engineering professionals can develop an appreciation of the role of other professionals in designing wearable devices?

Concluding Questions

6.1. To what extent do you feel you will be/were prepared to take the decision to work in the development of customisable wearable rehabilitation devices after you graduate/d? *

	1	2	3	4	5	
Extremely unprepared	☐	☐	☐	☐	☐	Extremely prepared

6.2 Additional comments:

6.3 What type of teaching and learning methods best support your learning to complement traditional lectures? (Select all that apply) *

☐ Interdisciplinary hands-on workshops

☐ Group work

☐ Discussion/Debates

☐ Independent study

☐ Learning alongside students from other relevant faculties

☐ Other:

6.4 Feel free to make any further comments and/or suggestions:

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