Chapter # 23

IDENTIFYING THE Ph.D. STUDENTS' NEEDS FOR CAREER ENHANCEMENT SKILLS

Alexandra Kosvyra[1], Dimitrios Filos[1], Tara Cusack[2], & Ioanna Chouvarda[1]
[1]Laboratory of Computing, Medical Informatics and Biomedical Imaging Technologies, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece
[2]School of Public Health, Physiotherapy and Sports Science, University College, Dublin, Ireland

ABSTRACT
To date, it is observed that an increasing number of Ph.D. graduates follow a career outside academia. The EU-funded CHAMELEONS project aimed to identify and fulfill the needs of Ph.D. students towards pursuing a career in digital and connected health industry. The CHAMELEONS overall goal was to develop innovative educational interventions offered by higher education to build more adaptable, entrepreneurial and employable graduates in both academic and non-academic environments. Thus, a range of courses or educational material provided by CHAMELEONS consortium members, or available in open platforms were identified, organized and offered to 15 students, of diverse background, enrolled in the program through a State-of-the-Art (SotA) toolkit. Two questionnaires were provided to attain information on: (i) background and skills the students recognized as underdeveloped, (ii) students' preferences in terms of interest, reasons, and motivation of selection and skills they aim to acquire using SotA toolkit. Students selected courses not actually improving hard skills needed for their research, but soft skills in the business and career management direction, focusing mostly on creativity, innovation, and communication. Finally, the students mentioned that the drive for their selection was based on self-awareness tools which identified the underdeveloped skills required for a successful career.

Keywords: PhD courses, extra-curricular activities, career enhancement, ESCO classification.

1. INTRODUCTION

The globalization and the advances in the technology sector have modified substantially modern life. The labour market requires new types of skills since jobs are becoming more knowledge- and skills-intensive. According to European Commission, by 2020 35% of all jobs would require high-level qualifications in the European Union (MEMO/11/615). This observation denotes that more jobs for those with higher academic qualifications, such as PhDs, will be involved in industry. Indeed, to date, less than 15% of doctoral graduates achieve a long-term academic career, with the remaining seeking employment in governmental or industry settings. This transition requires the restructuring of training programs in order to improve interdisciplinarity but also to enhance 'sophisticated skills useful in the workplace' (Roberts, 2018). As mentioned by (Bogle, Michel, Eggermont, & Willem van Henten, 2011), the skills researchers need are similar both inside and outside academia, and may include creative thinking, planning the implementation and verification of ideas in teamwork and communicating research. These skills will not only open up and maximize employment outside academia, but they will also address the EU's societal challenges. Moreover, diverse and interdisciplinary activities qualify students with such skills and experiences needed for their future careers (Patricio, & Santos, 2019). However,

while Europe has high-level skills needs, in many EU Member States there is an unmet demand for graduates in a number of areas including science, technology, engineering, and the medical professions (Relevant and high-quality higher education, 2023).

According to the (European qualifications framework (EQF), 2018), doctoral graduates should have "*knowledge at the most advanced frontier of a field of work or study and at the interface between field and the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice*". However, one major question remains and must be addressed: "Which PhD program characteristics are capable to improve employability for the PhD graduates, while also leading them to become big thinkers?"

1.1. Connected Health and the CHAMELEONS approach

As life expectancy has grown through the last decades, a need for more efficient healthcare systems has risen to support the increasing number of patients' care needs. Introducing state-of-the-art technology in healthcare has become essential in healthcare delivery and a wide range of disciplines, such as computer science, engineering, health and information technology (IT) design, can contribute to the improvement of patient management. This intersection of disciplines, known as Connected Health (CH) (Caulfield, & Donnelly, 2013), introduces the need to overcome disciplinary barriers and achieve inter-disciplinary interaction (Chouvarda, Mountford, Traikovik, Loncar-Turukalo, & Cusak, 2019). And thus, to achieve innovative creative CH solutions, not only several disciplines must work together in a more cohesive and meaningful way but also intersectoral cooperation is needed, by bringing together actors from universities, market and civil society sectors, to achieve efficient solutions in healthcare.

Highly skilled ambitious researchers who can address the most urgent and complex societal challenges in the CH domain are among Europe's emerging needs. However, PhD programs do not include activities to serve this purpose (Bosch, 2018) and broaden students' opportunities in various sectors, especially in Engineering and medicine domains (Lieu Tran et al., 2019; Cui, & Harshman, 2020). To achieve this, educational methods need to be introduced, empowering graduates to develop interdisciplinary, and intersectoral knowledge is crucial if we are to address current and future healthcare needs. (Mountford et al., 2018)

CHAMELEONS was a two-year research project (www.chameleonsproject.eu/) that received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 873105. CHAMELEONS was organized by an intersectoral and international consortium including five universities around Europe, namely (1) Aristotle University of Thessaloniki (AUTH) in Greece, (2) University College Dublin (UCD) and (3) Maynooth University (MU) in Ireland, (4) University of Porto (UP) in Portugal and (5) University of Oulu (OULU) in Finland. The objective of CHAMELEONS project was to design, deliver, and evaluate a range of interdisciplinary, intersectoral and international courses and educational material that will broaden PhD graduate skills, improve their employability in both academic and non-academic environments and equip them to solve societal challenges in the area of CH.

CHAMELEONS project focused on training 15 PhD students, through: (i) identifying and making available courses and educational material and (ii) co-design and deliver interdisciplinary, inter-sectoral, and international courses to improve their skills and employability, in a wide range of sectors, including academia, industry and entrepreneurship.

1.2. The CHAMELEONS State-of-the Art Toolkit for PhD Training

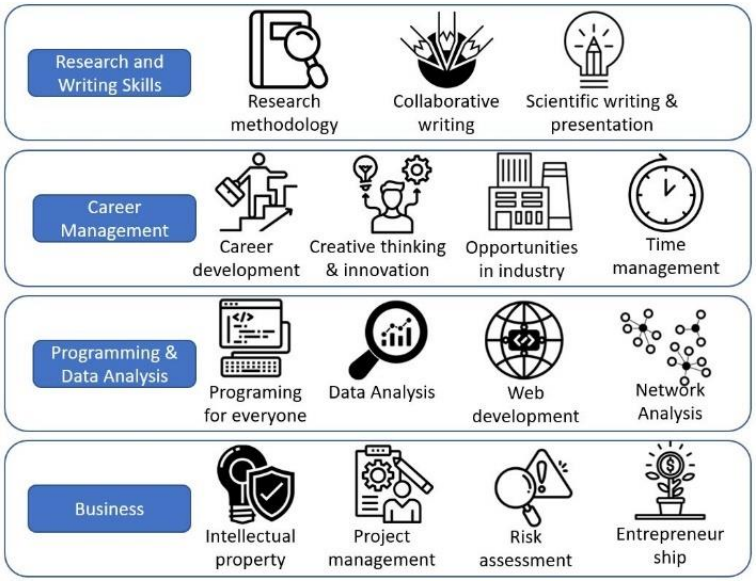
During the initial stage of the project, a screening phase in the five universities involved in the CHAMELEONS projects started in order to collect the views of those who attend interdisciplinary, inter-sectoral and international courses (young researchers) and those who design and implement such courses (Program Directors or equivalent). Interestingly, in those universities, it was revealed the limited availability of courses that are provided as part of PhD programs with the aim to broaden the career prospect outside academia. For this limited number of courses, the main characteristics were identified and used to inform the CHAMELEONS design requirements (Kosvyra et al., 2021).

Afterward, this list of courses was made available to the students participating in the project and were asked to choose up to three courses, based on their needs and interests, that they were willing to attend.

In addition, apart from the list of courses that are provided by the universities involved in the CHAMELEONS, a list of publicly available online courses or educational material that can improve future career opportunities, based on (Kosvyra et al., 2021), was created. In this respect, numerous platforms providing online courses were investigated (such as Coursera - https://www.coursera.org, udacity - https://www.udacity.com, FutureLearn - https://www.futurelearn.com etc.) as well as YouTube channels or IEEEtv (https://ieeetv.ieee.org/) were investigated.

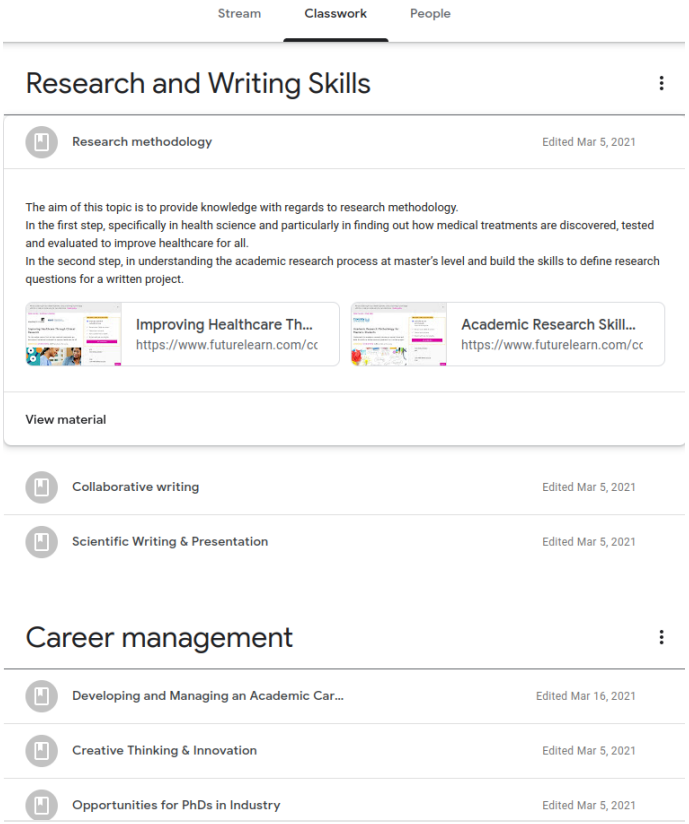
Following, the list of courses provided either by the CHAMELEONS universities or online platforms was divided into four categories, based on the: (1) the knowledge/skills they are providing and (2) the thematic area. In addition, each of the categories were further divided into sub-categories (Figure 1).

Figure 1.
The courses provided by the universities involved in CHAMELEONS project and the educational material that is available on the online platforms are divided into four categories, with each of them to be further divided into sub-categories. The icons of the figure were downloaded from the https://thenounproject.com/



The list of courses was included in a State-of-the-Art (SotA) toolkit, which was implemented using google classroom and is accessible through the CHAMELEONS website. The goal of the SotA toolkit was to provide any information for the courses or any educational material to the students in a condensed and detailed way. The structure of the classroom was based on the identified categories of courses, offering the user access to more information and details on the content and scope of each course, as depicted in Figure 2. The SotA toolkit was advertised through the communications channels of the consortium members.

Figure 2.
Implementation of the questionnaire in Google Classroom. The list of courses is organized into distinct categories according to the thematic area and the targeted skills. The general description of each category is provided, whereas the list of the courses is also available.



The goal of this chapter is to present the main motivation of the PhD students behind the selection of the courses or the educational material they prefer to attend during their PhD and associate them with the skills they aim to develop. A distinct analysis was made to investigate any differences in students' perspectives regarding the courses provided by the universities involved in CHAMELEONS and the courses or the educational material provided from open platforms. To this end, two questionnaires were developed aiming to identify how students recognize their needs and how they address them using these types of resources.

This book chapter attempts to identify the needs of PhD students towards preparing for their careers, by assessing their preferences for courses or activities outside their curriculum.

2. DESIGN & IMPLEMENTATION

To capture students' needs and their perspectives regarding the selection of the courses already provided by CHAMELEONS consortium, but also the courses or educational material that are provided through online platforms, two distinct questionnaires were designed and implemented as part of the SotA toolkit, in Google Forms. The answers were completely anonymous and no personal information was requested by the students.

2.1. Courses provided by the consortium members

The first questionnaire focuses on the courses provided by the universities involved in CHAMELEONS and it was organized into two parts. The first part of the questionnaire attempts to obtain more general information about the background of each student, the skills that they recognized as underdeveloped and the tools they used to identify them. Moreover, students were asked which of those courses they found interesting or useful for their career development during the first screening and considered them as potential candidates for attending.

The second part of the questions aims to attain information about the specific preferences of students for the courses made available to them, meaning how many and which courses they finally decided to attend. Since the period that students could attend a course did not overlap with the lockdown period due to the COVID-19 pandemic, face-to-face attendance was also possible, in addition to completely online provision. Moreover, students were asked to provide information about these specific courses in terms of interest, reasons, and motivation for selection and the skills they aim to acquire through these courses. With respect to the skills, students were called to identify them from a list of skills provided by the European classification of Skills, Competences and Occupation - ESCO (https://esco.ec.europa.eu/). This was adopted to enable linking these identified needed skills with other relevant resources developed at EU level.

2.2. Courses and educational material provided by online platforms

Similarly to the aforementioned questionnaire, a dedicated one was developed focusing on the courses and educational material provided via online platforms. Through this questionnaire, the users were asked to provide more details regarding the most interesting online material they attended, and the skills they aimed to improve through the specific material. The classification of the skills was also based on the ESCO categorization.

Finally, the experience of the students from the overall SotA toolkit use was also captured through those two questionnaires. In this respect, the users were prompted to provide their expectations from a tool like the SoTA and also their overall perception regarding the actual use of the tool.

3. RESULTS

This section presents the results of the questionnaires reflecting the choices of the students, as regards both the courses provided by the CHAMELEONS consortiums, and the educational material offered by the online platforms.

3.1. Students' Choices for synchronous Courses provided by the consortium

The results presented in this section include (i) the attributes of the courses and (ii) the skills that the students intend to improve by attending them. The questionnaire was answered by 13 students coming from diverse backgrounds. Specifically, 7 of them come from a technical/engineering background, 2 of them from the Business field, 3 of them from Education (Physical/Health) and 1 from a Healthcare background.

Among the 15 students that participated in the CHAMELEONS project, only 10 decided to attend courses with two of them selecting three courses, two students selected two courses, and six students decided to attend one course. For the remaining student, one student chose not to attend a course but used this opportunity for a short-term placement in another university to perform part of his/her research. As concerns the four that opted out, the reasons were mostly the limited time to offer in an activity outside their PhD program and the fact that they already have fulfilled the number of ECTS required to complete their studies. Thus, 10 different courses were selected and counted for the analysis as 16 individual selections representing all ten students' preferences (Table 1). Table 1 depicts the selected courses' titles, the duration of the course, the university that delivers each course, the number of students that selected it and the delivery mean. As observed, most of the students selected to attend courses of short duration (1 week) with the way of provision to be face-to-face.

Table 1.
Overview of the Selected Courses. Popularity is measured in terms of the number of students who selected the course.

Course	Length	Location	Popularity	Accessibility	ECTS
Creative Thinking & innovation	1 week	UCD	6	Face-to-face	5
Communication for Impact	1 week	UCD	2	Face-to-face	5
Social Entrepreneurship	8 hours	MU	1	Face-to-face	5
Design your Purposeful Life	1 week	UCD	1	Face-to-face	5
Basics in eHealth	5 weeks	OULU	1	online	5
Computational medical research	6 weeks	AUTH	1	online	4
Scientific Writing and Publication	81 hours	UP	1	Blended	7.5
Data mining	6 weeks	AUTH	1	online	4
Entrepreneurship: application and mindset	1 week	UCD	1	Blended	5
Exploring Intellectual Property	1 week	UCD	1	online	5

In order to understand better how the students identified their underdeveloped skills, 12 students used one or more SWOT analysis tools when deciding on the course to attend, while the 13th did not use such a tool. Most students used MyIDP tool (https://myidp.sciencecareers.org), while other choices included a self SWOT Analysis (Addams, & Allred, 2013), use of the PhD competencies model (phdcompetencemodel.nl)

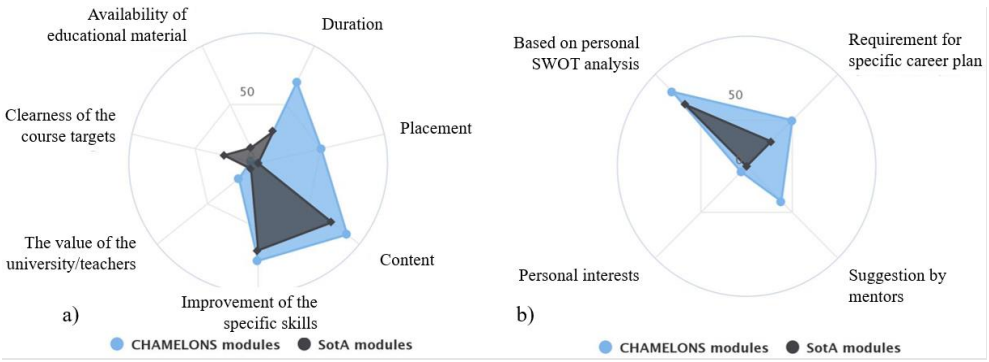
(Stouthard, & Cohen, 2016), an inhouse Career Goal Setting Tool, and Career Development Toolkit for Researchers (Jones). Mentoring and discussion of options with CHAMELEONS academic and non-academic partners was an additional optional step to facilitate decisions.

The underdeveloped skills identified belong to a wide range of skills, including mostly communication and creativity/innovation skills, and many others as business, presenting, research, teaching, time & project management, teamwork, data analysis and interpretation, and academic publishing skills. The courses from the Career Management and Business categories were identified by the students as the most interesting. The most popular course was 'Creative Thinking and Innovation', followed by 'Communication for Impact,' 'Creative Thinking & Problem Solving' and 'Design Thinking for Innovation'.

Table 1With regards to their categorization, 9 of them belong to the Business category, while 5 are in Career Management and 2 are in Programming and Data Analysis. The most voted reason for selecting a course, by taking into consideration the attributes of the specific course, was the content of the course (14 selections), followed by the specific skills' improvement with 12 selections, the course duration and the placement collected 11 and 8 selections accordingly. On the other hand, attributes like the value of the institution, the clearness of the objective and the available material appeared less important Figure 3a.

Regarding the motivator to identify the underdeveloped skills that affected their choice on course, 13 selections were based on students' swot analysis, 8 made the selection because specific skills were required for their career plan, while for 6 of them it was suggested by their mentoring panel. Only one student considered personal interests as a motive Figure 3b.

Figure 3.
Comprehensive view of students' reasoning for their choices for course selection regarding (a)its attributes (b) and their motivation, for the courses provided by CHAMELEONS consortium members (blue) and by SotA toolkit (black). The values are expressed as percentage of students that answered the specific option.

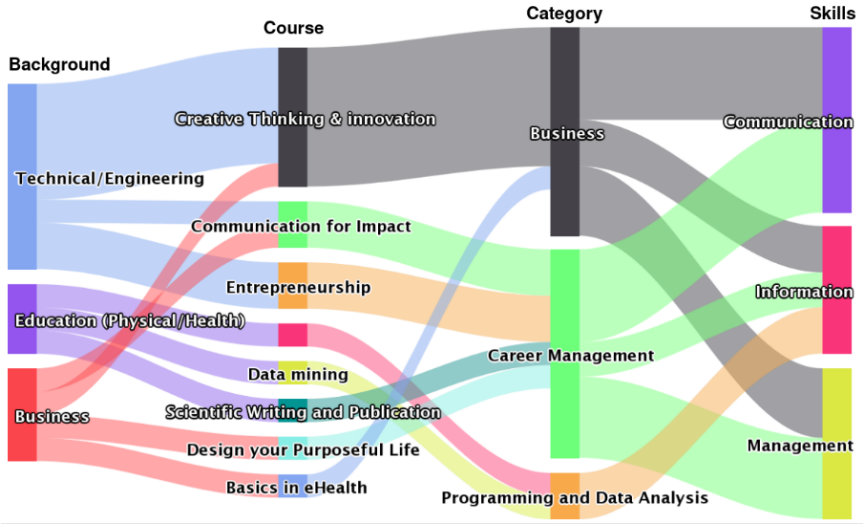


The specific skills that students aim to improve by the courses that they selected belong to 3 categories, 31 in Communication, 22 in Information and 26 in Management skills, while no student considered that the selected course will improve Computer Use related skills. Although 2 courses in Programming and Data analysis were selected, students aim to achieve Information Management and computer skills. Figure 4 provides an intuitive way to depict these skills in detail, capturing which of them were the most popular. As observed, students are heading in two directions, one is more practical and focused on developing plans to solve problems and create new products, while the other is more personalized including skills as processing and presenting information or making decisions.

Figure 4.
Popularity of skills that students intend to acquire.

Figure 5 presents a comprehensive view about which course each student selected and from which category, in relation to their background and the skills they aim to acquire from attending the course. It is noticeable that students from a technical background are moving towards enhancing their business skills, while some of them, along with the students from a business background, are focusing on career management.

Figure 5.
Comprehensive view of student's choices and expectations. The four columns in the graph represent: (i) Background: the educational background of the student, (ii) Course: The course selected, (iii) Category; The category the course belongs to, as it was defined in the google classroom, (iv) Skills: the ESCO category in which the skill that the student aims to improve belong.



3.2. Students' Choices for Courses or educational material provided by online platforms

In total, 10 users answered the questionnaire, most of which (5) declared technical background (engineering/informatics), three had clinical background, one had expertise in business, and one in project management.

According to the results, the material included in the Career management category was studied more by the users (7 selections), highlighting their anxiety for their life after the completion of their studies. In addition, 5 students attended material related to "research and writing skills" while two users declared that they attended material related to programming and data analysis.

Regarding the motivation behind the attendance of the material, 8 students answered that the main motivation behind the selection of a material was that they had experience on the topic, but they wanted to improve the skills that were covered by the topic while 6 students reported that the personal improvement and career enhancement guide their actions. In addition, the fact that they wanted to improve underdeveloped soft skills was mentioned by three users, while the duration of the material was also mentioned by 2 users.

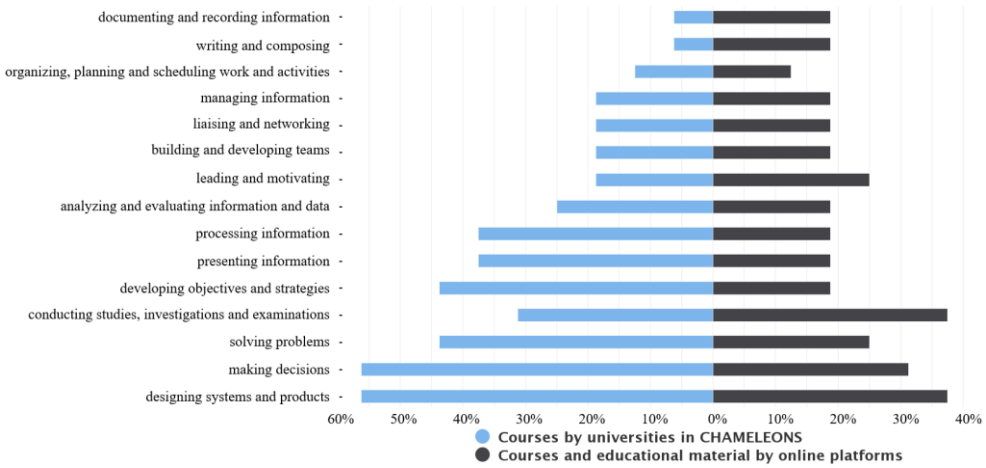
In addition, most of the users (7) answered that under these circumstances they prefer the online material to be provided in the form of online courses, 6 users answered that they prefer to study a book while three users (3) prefer to watch training videos.

From the analysis of the ESCO skills that were expected to be improved after the attendance of the courses through the SotA toolkit (

Figure 6), it was found that design thinking is the most targeted skill followed by the conduction of studies. Problem-solving and making decisions were also found to attract students' attention, similarly to the skills that are provided by CHAMELEONS consortium. Finally, the skills related to the processing and the presentation of information are also important for the students.

Figure 6.

Comparison of the main ESCO skills that are expected to be improved by selecting material provided by online platforms (black) and from CHAMELEONS consortium (blue). The skills are ordered based on their cumulative popularity in both approaches of course provision. The results are presented as percentages of the number of courses attended.



As observed, the main skills that the users expected to improve with the material they selected to attend, are related to the design of systems and products and conducting studies, investigations and examinations, while skills closely related to project management, such as decision-making, problem-solving, leading and motivating, were also considered crucial.

3.3. Overall SotA toolkit evaluation

A positive evaluation of the SotA toolkit was revealed since the students responded that they found it interesting while in general it was stated that the toolkit meets users' expectations with 6 users answering positively to the question "*Do you envisage a role for the learning you experienced through the SoTA toolkit in your own PhD*?", three users answered maybe while only one answered negatively.

When the users were asked to provide more details on the role that the SotA is envisioned to play in their PhD studies, one student, coming from business background, stated that the toolkit "*gave me clear focus on how best to maximize my networking and ensure I can work effective in teams in academia and practice*". In addition, most students mentioned that the specific learning could impact users' career with one student from informatics area of expertise writing that "*Yes, it could help me gain knowledge and experience in fields that are related to my career*" or another from engineering background to answer that "*I think that every additional skill that a person is obtaining is useful*".

4. DISCUSSION

The self-assessment of student's needs, the identification of the underdeveloped skills and taking actions can be considered necessary steps for career development. ESCO classification aims to provide a clear definition of the skills and several frameworks have been developed to support candidates to understand their needs (Fernández-Sanz, Gómez-Pérez, & Castillo-Martínez, 2017). In the context of CHAMELEONS project, a SotA toolkit was developed to support PhD students to develop their skills, by providing information for courses or educational material in a condensed and detailed way. Two questionnaires were designed to capture students' needs and expectations.

Taking into consideration students' responses, most of them considered it essential to use a self-awareness/self-assessment tool to identify the skills that they need to improve and help them make their selection in this direction. This fact proves that students are aware that they need to improve some skills that are not included in the narrow curriculum of a Ph.D. program and are willing to investigate their deficiencies and take actions to improve their competence in these fields.

It is important also that students seem to look to the future, since they selected courses that do not actually improve a hard skill needed for their current research, but soft skills in the business and career management direction, focusing mostly on creativity, innovation, and communication. Only students coming from an educational background were interested in developing a more practical skill from the Programming and Data Analysis category. It is worth mentioning that students with Business background were mostly interested in career management opportunities, while students with a technical background focused mainly on the business field.

Moreover, students are willing to attain skills such as designing systems and products, developing objectives, strategies, and decision-making, and processing information, skills that are needed for building a successful career in every sector. Students need to develop a multitude of skills providing knowledge on a variety of fields and learning to overcome the

cognitive, normative, and regulatory barriers so they can be a part of the CH system (Leniston, & Mountford, 2021).

Regarding the complementarity between synchronous (f2f) courses and asynchronous online material it was found that in most cases the ESCO skills sought to be covered by both options. For example, designing systems and products skill was a preference for both synchronous and asynchronous. On the other hand, skills like documenting and composing information, or writing and composing were more linked to asynchronous training, potentially due to the offline effort required.

With regards to the skills that the students are expected to acquire, it was found that skills related to communication are the most mentioned skills

Figure 6. Interestingly, as mentioned by (Mantai, & Marrone, 2022), communication was the most desired skill mentioned in PhD advertisements that were posted in Euraxess (https://euraxess.ec.europa.eu/), after the Degree and Achievements. Additionally, the ESCO skills that were expected to be improved after the attendance of the courses are also closely related to the most frequent skills shown in PhD admissions across several European countries, such as communication, interpersonal skills, and personal attributes.

Finally, we need to highlight that, while the students that answered the questionnaires come from different disciplines and countries, the number of CHAMELEONS students that provided the data used in this work is small. The results described above provide a descriptive overview of the identified trends. The findings can guide further surveys in different universities and programs and more extensive research must be performed to quantify the results towards evidence representative of the whole PhD population in Europe.

5. CONCLUSION

To conclude, PhD students in the wider domain of CH Technologies (Chouvarda et al., 2019), appear to have a need for developing skills beyond their basic scientific education, while also deepening their knowledge within the PhD. These skills are related mostly to creative and innovative thinking to create new products and provide solutions to the public. These choices are made based on the perspective of developing a successful career plan and being competitive in the occupational arena, taking also into account that Digital Health requires innovative and robust solutions. This study offers evidence and insights that can form the basis for the enrichment of future PhD programs in Europe.

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AUTHOR(S) INFORMATION

Full name: Alexandra Kosvyra
Institutional affiliation: Laboratory of Computing, Medical Informatics and Biomedical Imaging Technologies
Institutional address: School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece
Biographical sketch: Alexandra Kosvyra (female) has graduated from the Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki in 2014 and has received her MSc in Medical Informatics, School of Medicine, Aristotle University of Thessaloniki in 2018. She is currently a PhD student in the same Department in the area of Machine Learning in Genomics. She is a member of the Lab of Computing, Medical Informatics and Biomedical Imaging Technologies, Aristotle University of Thessaloniki since 2017 and has served as a junior researcher in the Institute of Applied Biosciences, Centre for Research & Technology Hellas (Greece) from 2017 to 2018. She has participated as research associate in 1 national (Greek) and 3 EU-funded research projects and has co-authored 10 peer-reviewed papers in international journals and conference proceedings.

Full name: Dimitrios Filos
Institutional affiliation: Laboratory of Computing, Medical Informatics and Biomedical Imaging Technologies
Institutional address: School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece
Biographical sketch: Dimitris Filos (M), Electrical Eng PhD, is a researcher in the lab of Computing, Medical Informatics and Biomedical Imaging Technologies, at the School of Medicine, Aristotle University of Thessaloniki, Greece. He is involved in the field of Digital Health and Medical Informatics for more than 10 years. His main scientific areas include biomedical signal processing, physiological systems and behavioural modelling, machine learning as well as data analytics and decision making. He has authored or co-authored several papers published in international journals, conference proceedings and book chapters.

Full name: Tara Cusack
Institutional affiliation: UCD School of Public Health, Physiotherapy and Sports Science, University College Dublin.
Institutional address: Belfield, Dublin 4, Ireland.
Short biographical sketch: Tara is an Associate Professor at University College Dublin where she is Head of Subject for Physiotherapy. Tara's research is predominantly in the area of education and curriculum development. She has participated in and supervised research in the areas of healthcare education and curriculum development. Tara is project coordinator for the Chameleons project where she led the development of bespoke doctoral education to improve employment opportunities for graduates. Tara was the HRB Health Impact Fulbright Scholar, where she examined interdisciplinary doctoral supervision in George Mason University in the US. Tara has published in journals such as Studies in Higher Education, Journal of Medical Internet Research and Learning and Instruction.

Full name: Ioanna Chouvarda
Institutional affiliation: Laboratory of Computing, Medical Informatics and Biomedical Imaging Technologies
Institutional address: School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece
Biographical sketch: Ioanna Chouvarda (F), Electrical Eng PhD, is Associate Professor in Medical Informatics and Biomedical Data Analysis, at the School of Medicine, AUTH. She has been involved in medical informatics research for more than twenty years, as regards biomedical data analysis and management, and the generation of eHealth systems and services, and has collaborated with numerous European research teams within EU projects. She has developed as series of undergraduate and graduate lessons in the domain of biomedical informatics, with an interdisciplinary scope. She is member of the IEEE (EMBS and WIE). She has authored more than 90 peer reviewed papers in international journals, as well as numerous papers in conference proceedings and book chapters.