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Factors Influencing Interdisciplinary Research and Industry-Academia Collaborations at Six European Universities: A Qualitative Study

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Abstract: The introduction of interdisciplinarity and industry-academia collaborations (IAC) into higher education institutions (HEIs) and curricula as tools for promoting sustainable development has been debated both in academic and non-academic contexts. While overall rising trends in the acceptance of interdisciplinarity and IAC exist, research has stressed difficulty in implementation and practices. We conducted eight focus groups at six European Universities (members of the SEA-EU alliance) and analysed the transcripts using Braun and Clarke's reflexive thematic approach to qualitative analysis in order to develop themes on barriers and facilitators to both conducting interdisciplinarity and IAC, as well as the inclusion of university students in interdisciplinary research. We observed that the main barriers to IR and IAC and the inclusion of students in such activities include traditional HEI structures focused on single-discipline approaches, a lack of joint platforms for IR and IAC, and academic differences (publication outcome differences, academic background). Likewise, a lack of funding (especially for early career researchers), employability (for students willing to do a research career), and a lack of validation by HEIs for researchers conducting IR and IAC are major barriers. To IDR- and IAC-related activities, a top-down approach is needed to restructure HEIs and make them more accommodating to both students and staff willing to conduct IR and IAC activities, thus refocusing them towards sustainability.

Keywords: interdisciplinary research; industry-academia collaborations; technology transfer; interdisciplinarity; knowledge transfer; higher education institutions; sustainability; sustainable development

1. Introduction

Amidst global changes and new trends, one of the biggest challenges for Higher Education Institutions (HEI) is the transition of knowledge gained at universities towards industry [1–3]. Considering the United Nations' Sustainable Development Goals (SDGs), creating sustainable education focused on "relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship" [4], will be one of the main achievements HEIs will strive to achieve by 2030. Policymakers and researchers in Europe increasingly support the strengthening of interdisciplinarity and industry-academia collaborations (IAC) [5,6]. Factors contributing to this shift include the current job market, the necessity of adapting curricula to newly developing technologies, and the universities' need for new funding resources [7].

HEIs have been introducing technology commercialization and entrepreneurship courses [8–12], providing their students with valuable skills for starting businesses or developing technologies within existing ones. Nelson and Monsen [11] emphasize that entrepreneurship education and technology transfer (TT) education mostly have little overlap, the latter having intellectual property and university-industry relations as dominant topics, among others. Recent research has emphasised the role of students in TT, particularly graduate ones [13,14]. For engineering degrees, new approaches have appeared for achieving TT and entrepreneurship education [15–17]. Besides being directly involved in technology commercialization, students indirectly drive knowledge transfer by engaging in IAC [18]. As universities create more IAC opportunities for students, it is unclear if they are adequately prepared for research experiences in the industry.

TT and interdisciplinary research (IDR) are expected to be the determinants binding education, research, and the industry in answering future industry-related challenges [1]. This was recognized by European universities, with the Horizon Europe 2021–2024 strategic plan emphasising collaboration between disciplines and the transfer of knowledge into industry [19]. Many universities have started to run interdisciplinary studies to meet global trends [20] due to interdisciplinarity's use in detecting and solving complex problems through comprehensive understanding [21] and its use in achieving sustainable development and SDGs [22,23]. Researchers and policymakers have also increasingly investigated interdisciplinarity at HEIs, deeming it essential in creating integrative knowledge, opposing specialization and single-discipline approaches preferred by some researchers [24–28]. Introducing interdisciplinarity to HEIs with traditional, single-discipline-oriented structures can help advance sustainability in science and practice [26], and HEIs are creating programs that are more inclusive, less discipline-oriented, and more focused on complex problems dependent on practice-based knowledge [29]. Studies have shown an increase in IDR, interdisciplinary teaching, interdisciplinary degree programmes, co-operations between multiple institutions [30], and interdisciplinary project funding [31].

However, researchers have also highlighted numerous issues with implementing interdisciplinarity. Traditional university structures, often focusing on single disciplines, prevent including students in IDR, especially at undergraduate (bachelor/master's) levels [16,20,32]. Research on funding for interdisciplinary projects [33], IDR citation and impact [34–36], and relationships between researchers from different disciplines [37] have delivered inconsistent results about their impact on HEIs and academia. Moreover, university curricula, often focused on traditional, research-based education programs and concepts, have been shown to conflict with non-academic collaborations, including IACs [38]. Additionally, a lack of validation of non-academic activities such as IACs by HEIs and differences in project outcomes between academia and industry have also been shown to have a negative impact on IACs [39–41].

Given the significance of these barriers, we sought to discover which factors affect the involvement of students in IDR and IAC at six European universities within the SEA-EU alliance, whose goals are "to strengthen the links between teaching, research, innovation and knowledge transfer" [42]. Through focus groups, we also wanted to explore a wider range of phenomena related to conducting IDR or IAC, such as the barriers and facilitators observed by academic staff, researchers, and students, with the goal of informing European policymakers on methods for promoting IDR and IAC.

1.1. Literature Review

1.1.1. Interdisciplinarity in Education

Despite the ancient, Platonic origins of the concept of interdisciplinarity, it became more present in curricula only in the 20th century, initially focusing on educating individuals who are "generalists" (not specialized in single disciplines or vocations) [43]. The seminal research on interdisciplinarity in an educational context was conducted by the Organization for Economic Cooperation and Development's (OECD) Centre for Educational Research and Innovation in the 1960s [43] in response to growing interdisciplinary trends at HEIs. The OECD report defined interdisciplinarity as "the integration of concepts and methods between disciplines in teaching and research" and marked the turning point for discussions on IDR in an educational context, highlighting that "creative change in university education and research calls increasingly for an interdisciplinary approach to teaching" [44].

Most approaches to interdisciplinary education focus on the concept of "integration" of knowledge, theories, and methods from various disciplines [43,45,46]. Klein [47] posits it as one of the key characteristics of interdisciplinarity, along with interaction, focusing, blending, and linking. He also states that integration is "not merely the endpoint nor the ultimate purpose of interdisciplinary inquiry, but (. . .) embedded in complex, often circuitous investigative processes" [46]. Interdisciplinarity "integrates information, data, methods, tools, concepts, and/or theories from two or more disciplines" and synthesises them to solve complex, novel problems [48].

For example, neo-Piagetian approaches to interdisciplinary education outline that interdisciplinary learning occurs in two stages; initially, isolated concepts from two separate disciplines are learned, only to be later unified into more abstract, novel interdisciplinary themes [43,48]. Pragmatic-constructivist theory, however, proposes an iterative process grounded in a synthesis of "disciplinary insight", "critical stance", "leveraging integrations", and "interdisciplinary purpose", constantly evolving through a learner's reflection, thus fostering interdisciplinary understanding [46]. Both approaches have "integration" as a vital factor in the process. However, integration, interaction, and synthesis often clash with both epistemological disciplinary traditions and academic, disciplinary structures, making interdisciplinary HEI education a complex problem [43,45]. In fact, interdisciplinarity is thought to lack "the autonomy, stability, and definitiveness" of disciplinary hierarchies, as it is based on the interaction between individuals from different disciplines, the integration between knowledge from specific disciplines, and a purpose or problem shared across disciplinary boundaries [43,45]. In our study, interdisciplinarity, interdisciplinary education, and IDR are considered in this frame of integration, interaction, and synthesis of problems, methods, theories, and knowledge from varied disciplines, in contrast to "disciplinary" academic structures.

1.1.2. Interdisciplinarity, Multidisciplinarity, and Transdisciplinarity

Historically, the difference between interdisciplinarity (ID), multidisciplinarity, and transdisciplinarity has been a subject of academic debate [49] and primary distinctions can be traced back to the OECD [44,45]. Multidisciplinarity "overflows disciplinary boundaries" as a joint approach to a problem between disciplines, with each remaining distinct, yet "linked by a topical focus" [49–51]; as such, it is based on cooperation among researchers from different disciplines and lacks the integration and synthesis characteristic for interdisciplinarity [43–45]. Transdisciplinarity, however, goes "beyond" disciplines, focusing on solving real-world problems, often with the participation of non-academic stakeholders [50–52]; it focuses less on synthesis, and more on the problem-solving benefits collaborations between disciplines can bring and the new knowledge and applications it can create [44,45,47].

1.1.3. The University's Third Mission

Classic interpretations of relations between academia and industry are focused more on "payment for services rendered", with academics offering their specialty to industry partners in return for consultation fees or creating their own businesses during or after academic careers [53]. Industries perceived academia as "a source of human capital, future employees and (. . .) knowledge", while HEIS remained in their traditional "research and education" roles [53]. However, Etzkowitz [53] places a "second revolution" in the 1980s, in which industries primarily capitalize on the knowledge created at universities, while universities play a more significant role in economic developments, adopting "industrial research goals, work practices and development models, resulting in a mutual integration of two initially separate entities.

Contemporary research now focuses on the "Third Mission" of universities, a framework comprising a "triple helix" of collaboration between HEIs, industry, and government, with the aim of increasing the transfer of knowledge and technology from universities to the private sector, thus increasing the societal impact of HEIs [54–56]. It also includes the promotion of entrepreneurial education through systematic policy reforms and HEI restructuring [57,58]. The rise of this third mission is also correlated with globalization processes, and environmental and financial crises, thus adding the concept of sustainability in the HEIs "Third mission" [56]. However, this "Third mission" also clashed with the classic academic mission of research and teaching, with researchers opposing a "one-size-fits-all" approach to implementing it at HEIs [56,59]. Given the importance of TT and entrepreneurship education to the UN's SDGs [4] and European institutions [5,6], our study will look for barriers in implementing IACs and entrepreneurial education at HEIs.

1.1.4. Qualitative Research and Focus Groups on Education and Industry

Qualitative research has seen extensive use in social and educational sciences aiming to "understand a social experience or phenomena" of persons involved in educational processes [60–62]. Cooley [61] posits that qualitative research can contribute to policy debates and educational reform more than quantitative research, as complex social problems and structures cannot always be investigated by quantitative methods. Merriam [63] outlined that researchers are no longer debating the merits of qualitative educational research, but are rather discussing methods and approaches. Qualitative analyses and focus groups have long been used in research both inside and outside educational contexts [64–66]. They are useful in exploring people's shared experiences [64] and opinions about an idea or social phenomenon [44]. In IAC research, qualitative methodologies have also seen practical uses, either through document and policy reviews grounded in thematic text analyses and syntheses or thematic interview analyses, especially in investigating barriers and facilitators to IAC activities [53,56,67,68]; researchers also outlined that focus groups were initially used in entrepreneurial contexts [64,65]. Given our study aims, qualitative methods and focus groups were the best approach to analysing the phenomena of interdisciplinarity and IAC among the sample HEIs.

2. Materials and Methods

2.1. Participants and Research Team

Participants were selected using purposive sampling among researchers and students at the six SEA-EU alliance member universities: University of Kiel (CAU), University of Western Brittany, Brest (UBO), University of Gdansk (UG), University of Cadiz (UCA), University of Split (UNIST), and University of Malta (UM). The focus groups were held by UBO, UCA, UG, UM, and UNIST. CAU did not participate due to the COVID-19 pandemic. A pilot focus group including twelve participants from each partner university was organized at UNIST to assess the appropriateness of the questions for the study aims. Students and researchers were divided into separate focus groups, as we wanted to observe insights from each group separately and ensure they felt comfortable answering questions in the presence of their peers only. The total sample included 52 respondents in eight focus groups. Table 1 shows the number of participants in each focus group and their declared sex. Table 2 shows the moderators' and data analysts' backgrounds.

Table 1. Number/sex of participants in each focus group.

	UBO		UCA		UNIST		UG		UM
	Researchers/ Academic Staff	Students	Researchers/ Academic Staff	Students	Researchers/ Academic Staff	Students	Researchers/ Academic Staff	Researchers/ Academic Staff	Researchers/ Academic Staff
Male	6	2	4	2	5	4	4	4	4
Female	2	4	3	4	4	2	0	2	2

Table 2. Moderators and their backgrounds.

Sex (M/F)	Study Role
F	Moderator—focus group with researchers and staff
M	Moderator—focus group with students
F	Moderator—both focus groups
M	Moderator—researcher/academic staff focus group
F	Moderator—researcher/academic staff focus group
F	Moderator—both focus groups
M	Data analysis
M	Data analysis

2.2. Recruitment Strategy

Researchers were identified via institutional websites and approached directly or by e-mail. Students were recruited through an English language advert, through their institution's digital newsletters, via department mailing lists, or through project researchers' network of contacts.

2.3. Focus Group Topic Guides

The focus groups lasted for approximately 120 min. In the first ten minutes, the SEA-EU project was presented to the participants, along with the plan and aim of the focus groups. The topic guides with questions for the focus group are presented in Tables S1 and S2 in the Supplementary Materials.

2.4. Data Collection and Anonymization

Due to the limitations from the COVID-19 pandemic, all focus groups were held online on the Zoom virtual platform (Zoom Video Communications, Inc., San Jose, CA, USA, 2022), which was used to audio-visually record the focus groups. Each focus group was moderated by one moderator. All focus groups were held in English. The raw data for the analysis were then collected in the form of focus group transcripts, which were transcribed automatically using the NVivo Transcription software (NVivo Transcription, QSR International, London, UK, 2022). Eight focus group transcripts were collected. The transcripts were then checked for clarity and correctness against the focus group Zoom recordings. Anonymization was carried out manually by the moderator of each focus group. Participants were coded by their university and focus group (e.g., UBO, Researchers/staff) to ensure full anonymity.

2.5. Data Analysis

For the data analysis, we used Braun and Clarke's reflexive thematic analysis approach due to its adaptability in analysing data [69]. This approach consists of six steps in which the coders; (1) familiarize themselves with the data by re-reading the transcripts, (2) generate the initial codes, (3) search for themes, (4) review them, (5) define and name them, and (6) produce the final report. In this study, the data were coded by one coder (LU) through an inductive approach after reading and re-reading the transcripts and revised in collaboration with a second coder (IB) after the initial coding. Codes and themes were developed from the data on a semantic meaning level. The codes and participant quotes were entered in an Excel spreadsheet (Microsoft. Washington, DC, USA; 2016). The initial themes were then found, defined, and named, and revised by two coders (IB and LU). Data saturation was not used due to incompatibility with the chosen approach [70]. The participants were not contacted for feedback on the findings. No field notes were taken. We used the Consolidated criteria for reporting qualitative research (COREQ) guidelines to report the results [71].

2.6. Ethical Approval

As the study included human participants and their data, approval was sought from and given by the Ethics Committee of the University Department of Forensic Sciences, University of Split, on 12 January 2020 (approval no. 2181-227-05-12-21-0001; 641-01/21-01/00001). All participants filled out informed consent statements and confidentiality agreements.

2.7. Funding

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3. Results

Three main themes were developed from the data: (1) Existing barriers and facilitators to IDR and IAC, (2) Increasing the involvement of students in IDR and IAC, and (3) Enhancing the social impact of research—delimitations between academia and society and ways of overcoming them. Barriers to IDR and IAC affected both the involvement of students in IDR and IACs and initiatives aimed at increasing the social impact of research in various ways. For example, by inadequately valorising and evaluating non-academic research projects and IACs and IDR which do not necessarily result in publications; this discouraged students and researchers from engaging in IDR and IAC, both of which were thought to have a bigger social impact than traditional, single-discipline research. Moreover, these inadequate evaluations especially discouraged students and researchers from becoming involved in IDR, as they would have a lower chance of obtaining funding, research positions, or career advancements at HEIs. Any initiatives towards overcoming these barriers (i.e., facilitators) could also increase the engagement of students in IDR and IAC, as they would see that their engagement in IDR and IAC activities would in some way be rewarded. The social impact of research also affected the involvement of students in IDR and IAC; one of the positive aspects that students observed for IDR and IAC was their increased social impact when compared to traditional, single-discipline research (Figure 1). The themes and subthemes are shown in detail, along with participant statements in the following sections. Additional participant statements related to the themes and subthemes are available in the Supplementary Materials (Table S3).

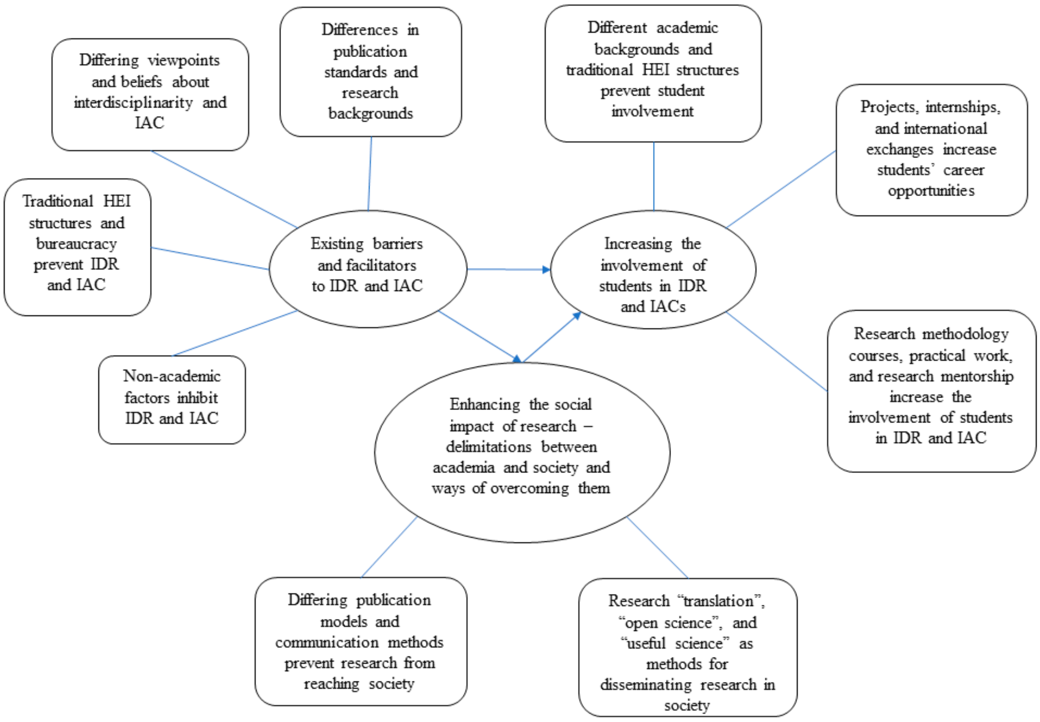

Figure 1. Thematic map of themes and subthemes. IAC—industry-academia collaborations, IDR—interdisciplinary research, HEI—higher education institution.

3.1. Theme 1: Existing Barriers and Facilitators to Interdisciplinary Research and Industry-Academia Collaborations

Researchers, academic staff, and students observed numerous barriers and facilitative factors to IDR and IAC. Four related subthemes were developed: (1) differing views on interdisciplinarity and IAC; (2) inhibitors in HEI structure and bureaucracy; (3) difference in terminology, limitations, publications, and research outcomes between disciplines and in industry; and (4) non-academic inhibiting factors.

3.1.1. Subtheme 1: Differing Viewpoints and Beliefs about Interdisciplinarity and Industry-Academia Collaborations

There were significant differences between researchers/staff in interpreting what interdisciplinarity is and distinguishing it from concepts such as "multidisciplinarity".

> *"I think (. . .) more precision [is needed] about what interdisciplinarity is, which is different from multidisciplinarity. We took the examples of projects involving different sciences or different researchers from different sciences. If they all work side by side, if they never cross or share or build bridges or explore new ways to analyse (. . .) new issues, then that's multidisciplinary."* (UBO, Researchers/Staff)

Despite this, most researchers/staff stated that interdisciplinarity is not a novel approach to research, but rather a common occurrence in science. In practice, other disciplines' inputs are needed by most scientific disciplines in conducting research.

> *"(. . .) I cannot do research without it, because I do ecology, benthic vegetation. So, I need physics. I need sediment dynamics. I need chemistry. I could not do any type of research if we're not having interdisciplinarity."* (UCA, Researchers/Staff)

For most participants, IDR has more potential in creating new methods and knowledge for solving research problems. It also opens novel research problems which would otherwise be unexplored in single-discipline research.

> *"Interdisciplinary research is interesting because it allows to enlarge the research and to increase creativity (. . .) of thinking about a given problem with all the people having a different point of view."* (UBO, Researchers/Staff)

> *"(. . .) it [interdisciplinarity] means people with different backgrounds, no? Working together so they can share different expertise and (. . .) have very different points of view that can complement and can bring better creative solutions (...)"* (UCA, Students)

For students, disciplines were also often interrelated in practice, and including experts from other fields was necessary for achieving research goals. Interdisciplinarity would be crucial to a students' future development and career.

> *"(. . .) in my field (. . .) it's a common practice to involve other people that are not conservators (. . .) I have some experience working in a lab, but I would rather somebody else who has more experience and has finished chemistry and has a degree on it to work on some kind of testing for me that I need."* (UNIST, Students)

> *"I think it's necessary for our future career. That's important, to have experience in interdisciplinary research."* (UCA, Students)

However, certain participants noted that interdisciplinarity was becoming a "buzzword" for grant applicants, often used with the goal of gaining additional funding. They believed interdisciplinary approaches to research problems should not be forced to obtain more funding, but rather implemented if the problem requires it.

> *"At European level, it's this multidisciplinarity, it's a kind of buzzword (. . .) which is cool today. I think that (. . .) most of the projects are also forcing this kind of collaboration . . . to get more points, better evaluation."* (UNIST, Researchers/Staff)

A similar divergence of opinions occurred when discussing IACs. Some researchers saw them as unachievable, as HEIs and researchers are usually publicly funded, and the goals and needs of research and industry are often contrasting. Industry stakeholders expect short-term results, which researchers cannot easily deliver. There is also the issue of interest, as industry needs often conflict with ideals of open and shared science.

> *"The difficulties of industry, they come in a boundary between when a company makes profits from something (. . .) done with your work that is somehow paid by the people through their taxes."* (UG, Researchers/Staff)

> *"... working with companies, industries, it may be difficult to do research because they (. . .) want short term results."* (UBO, Researchers/Staff)

However, participants stated that researchers coming from industry often have a better perception of research problems and can offer new methods for solving existing problems with research or reveal new topics altogether.

> *"(..) we have had (. . .) people that were very successful professionals in the industry . . . that identified the need for a new methodology and similar. So, they enrolled in a PhD program, used scientific methods to develop a new methodology (...)"* (UNIST, Researchers/Staff)

Our participants mostly had a positive stance towards interdisciplinarity, at least when it was truly achieved and not used as a "buzzword". IAC were seen as problematic to achieve due to varying interests and expectations between researchers and industry.

3.1.2. Subtheme 2: Traditional HEI Structures and Bureaucracy Prevent Interdisciplinary Research and Industry-Academia Collaboration

Participants in the researcher/staff focus groups observed that traditional HEI structures separating departments both in the legal and academic sense were seen as one of the main barriers to conducting IDR.

> *"Nowadays, people would be interested in doing interdisciplinary things (. . .) but somehow the structures that are in place bureaucratically at the university don't quite allow for this communication and cooperation to actually take place."* (UG, Researchers/Staff)

To overcome this problem, participants suggested HEIs could organize seminars or conferences in which researchers from various departments and even universities could participate.

> *"(...) I would really like to see more cross-faculty seminars, or cross-institute, because (. . .) that would be great to be stimulating from this research."* (UG, Researchers/Staff)

Most participants observed HEI bureaucracy impeding IAC and a lack of information on how to contact industry stakeholders. Even when contact was achieved, establishing collaboration was difficult due to bureaucracy.

> *"I don't collaborate with any company or NGO yet, but if I think about something that is very difficult, maybe the bureaucracy (. . .)"* (UCA, Students)

> *"But if you got, for example, challenges for a corporation (. . .) because it's very simple and easy from the other side, and from our side, it's almost impossible to organize other things, to go through the whole documents and bureaucracy (. . .)"* (UG, Researchers/Staff)

A lack of trust between HEIs, public institutions, and industry stakeholders also affected non-academic collaborations. Certain participants suggested that universities should not take their societal status and reputation "for granted" and should work more on making themselves into "trustworthy brands".

> *"I'm learning again from my few months of experience (. . .) that we perhaps overestimate a little bit the reputation of the university (. . .) a university has to work hard to build a reputation out there (. . .) there is a lot of a stereotype out there that the university is a bunch of people and ivory towers that essentially don't do that very lucrative business."* (UM, Researchers/Staff)

According to our participants, the issue of HEIs validating IDR was also tied to the publication debate. As differences exist in research dissemination between disciplines, HEIs have difficulties evaluating a researcher's contribution to a project with multiple authors from different disciplines.

> *"If people are not from the same discipline, the evaluation rules are not the same, and that it is very difficult to find a good trade-off in which every people can work (. . .)"* (UBO, Researchers/Staff)

The validation issue persisted in IAC. Some participants in the research groups found no incentive to conduct research if it is not formally recognized for the purpose of career advancement.

> *"So, if the university, in terms of promotions, appreciates that, then I think people will be more encouraged to do these kinds of [industry-academia] collaborations (. . .) But if collaborations don't count, then you have a problem."* (UM, Researchers/Staff)

To facilitate both IAC and IDR, HEIs must offer top-down solutions to establishing contacts between researchers from different disciplines and between departments and non-academic partners. Likewise, a different system for evaluating interdisciplinary publications or non-publication research outcomes should be established to entice researchers towards IDR and IAC, equalizing it with traditional HEI evaluation systems.

3.1.3. Subtheme 3: Differences in Publication Standards and Research Backgrounds

Differing publication standards between disciplines were a critical inhibitor to ID collaborations for most researcher-participants. Differing research outputs among disciplines was also a point of contention. Another observed barrier was the more complex review process for IDR than for single-discipline research.

"(...) people do not look for zonal publication so much because there is a great conference at which you have to be. If you are not at those conferences, your CV will be less interesting when you apply for a job. For a discipline's conference, the interest is not the same, and they prefer to publish the results." (UBO, Researchers/Staff)

"(...) many times reviewers come from an area. They see things in an area, and it's very difficult for them to see beyond [it]..." (UM, Researchers/Staff)

Another academic factor inhibiting research important for participants is the difference in "starting" knowledge of researchers and students. Initial collaborations require a consensus on basic terms and a lack of homogeneity in interdisciplinary knowledge can cause inertia in conducting a project. The difference in research priority between disciplines can be a cause for dissent.

"Where you have discipline1 and discipline2 (...) and the objective is to design a new kind of xx, and each of the two groups assumes that the other group's issues that they have to face could be very simply solved." (UBO, Researchers/Staff)

Participants focused on the standards of "open science" and the fostering of "open communication" as the solution to the knowledge-gap problem. These two phrases are closely connected to ideas of knowledge-sharing and transparency between disciplines.

"To me, it's an open and proactive communication process at different levels between... partners in interdisciplinary projects and taking this into account." (UBO, Researchers/Staff)

For participants, a researcher's/student's "specialization" or training in a specific discipline was seen as one of the reasons behind this problem. This "specialization" also prevented researchers from realizing the limits and problems in other research disciplines, which was a potential cause for miscommunication.

"There is a huge knowledge gap (...) when you're working in interdisciplinary matters, and you realize that in fact, you don't know much, that you have been specialized in your field." (UBO, Researchers/Staff)

Divergence in knowledge, publication outcome, and approaches between disciplines were key problems to our participants in taking up and conducting IDR. "Sustainable" IDR can only be achieved when interdisciplinary education on approaches and methods becomes inherent to curricula, so that the differences between disciplines are lessened pre-emptively.

3.1.4. Subtheme 4: Non-Academic Factors Inhibit Interdisciplinary Research and Industry-Academia Collaborations

Researchers also noted inhibiting factors related to researchers' personal characteristics. A lack of "humbleness" and a researcher's "ego" prevented or limited collaborations between researchers.

"There are problems of ego. There are problems of territory. There are problems of security. So, someone wouldn't be comfortable working with someone else because he or she feels insecure." (UM, Researchers/Staff)

Student participants also focused on the importance of a researcher's personality in interdisciplinary collaborations. Adaptability, open-mindedness, and transparency were seen as crucial traits a researcher should have.

"(...) We have to adapt ourselves because it is really rewarding to have these kinds of studies (...) I think we have to adapt all the time to be a good researcher." (UBO, Students)

Both the researchers and the students noted that differences in language and culture can also affect research, especially in an international context.

"The issue(s) that you can have when you go to a [different] country, that you don't know the culture and you don't know the rules or the background of the people or the language." (UBO, Researchers/Staff)

Linguistic, cultural, and personal differences between researchers were seen as problematic in IDR and international collaborations. Policies and programs should take non-academic factors into account and offer ways of mediating these issues.

3.2. Theme 2: Increasing the Involvement of Students in Interdisciplinary Research and Industry-Academia Collaborations

The second theme deals with the involvement of students in research in general, with an accent on IDR. The inclusion of students in academia-industry collaborations was also discussed. The theme can be divided into three subthemes: (1) barriers in academic background and HEI structures; (2) research mentorship, research methodology courses and practical work; (3) projects, internships, international exchanges, and opportunities for career-building.

3.2.1. Subtheme 1: Different Academic Backgrounds and Traditional Higher Education Institution Structures Prevent Student Involvement

For students, conducting IDR is difficult as they usually obtain knowledge from a single discipline during their HEI education. This lack of knowledge inhibits communication with students and researchers from other disciplines, as it presents a higher risk of miscommunication.

> *"You have to be aware [of] and compose with different disciplines, sociology, and economics (. . .), geography, politics (. . .) sometimes it is frustrating because you can't have all the terminologies, knowledge or knowhow and stuff."* (UBO, Students)

Among the researcher participants, most thought that institutions also do not provide support for students pursuing IDR careers. Participants found this was caused by a lack of paid positions for early career researchers (ECRs) interested in IDR or by a lack of courses and degree programs for those students interested in IDR.

> *"I feel that somehow our students are also punished because of this interdisciplinarity (. . .) They do not have a clear scope (. . .) for pursuing a research career. Only people with very clear skills are hired by other institutions."* (UG, Researchers/Staff)

The non-existence of courses, platforms, and programs for students interested in IDR was a significant obstacle for the student participants, as students and ECRs had no methods of contacting people from other disciplines.

> *"For example, if I need to go to work, I don't know, in the Urban Institute with some specific documents I am not familiar with, I would be grateful to have someone specialized in that as a support, with the ability to reach this person when needed."* (UBO, Students)

The same issue occurred with students willing to collaborate with stakeholders in the industry. A solution could be a "directory" of "friendly" companies, which students could use to approach companies in need of applying their skills and knowledge.

> *"I think [ANONYMIZED] said before about another thing (. . .) friendly company's directories. (. . .) a place that you can go and see, OK, this company can be interested in what I'm doing. I'm going to email them and talk to them (...)"* (UG, Students)

Time constraint was a significant issue for both researchers and students in involving students in research. Students are usually occupied with obligations to varied courses, or they already have part-time jobs which they must balance with academic life. Researchers, on the other hand, are swamped with teaching and research obligations and have almost no time for additional projects with their students or training them for future research careers. The issue of time is more prominent during time-constrained student exchanges and internships.

> *"The time (. . .) to teach the student before he is able to conduct the experiments by himself (. . .) can sometimes be very tricky, especially if you have to supervise the students for a short internship."* (UBO, Researchers/Staff)

"(. . .) In my case, the interdisciplinary research involves biomedical researchers and physicians while I am a master student. But, although my project involves working with specialists from other disciplines, they usually had very little time to discuss the project with me." (UNIST, Students)

Traditional HEI structures need to be reshaped into less rigid structures to accommodate IAC and IDR. Logistic and bureaucratic support and the organization of open communication channels between researchers and industry stakeholders, and within research communities themselves, are crucial in developing new academic and non-academic collaborations.

3.2.2. Subtheme 2: Research Methodology Courses, Practical Work, and Research Mentorship Increase the Involvement of Students in Interdisciplinary Research and Industry-Academia Collaborations

Participants from both groups emphasized a lack of pre-university and university-level education on skills such as critical thinking, which reflects their capacity to conduct research autonomously. To mitigate this, it is best that the research methodology be introduced at earlier stages of education, and students should be trained to think and decide for themselves.

"I think it's the only (. . .) possible way to develop this kind of critical collaborative thinking (. . .) from the elementary school." (UNIST, Researchers/Staff)

"(. . .) but what I think would be even better if the classes like methodology (. . .) were to be at the beginning of your educational studies in college." (UNIST, Students)

However, students remarked that even when adequate research methodology education existed, a noticeable lack of "practical" work impeded student research participation. An increase in practical courses or short-term projects was thought to increase student interest in research.

"(. . .) more practice courses or longer practice courses. Because what disappointed me is that, during my studies, generally, the practice is very short, like three or four hours, and so we don't really have the time to explore any problem or to understand what we do." (UBO, Students)

A lack of practical work, or opportunities to do research, along with unpreparedness for what research entails (e.g., unexpected, disappointing results), was perceived as a significant inhibitor to a student's willingness to engage in future research activities. This also impaired student participants from engaging in research careers, which is potentiated by the scarcity and shortness of employment opportunities in research.

"(. . .) they are not investing [in] people. That is the biggest problem. If there is (. . .) a possibility for this teaching assistant and research assistant to start to build a career (. . .) [at a] university with the kind of security that could help more to get people who would like to be like research leaders in the future." (UM, Researchers/Staff)

Alternatively, student-participants offered that research methodology education should contain some aspects of "real research", as they were unfamiliar with the difficulties a researcher faces and had to learn during internships. This could be realized through "open door days", in which students can be introduced to real research.

"I would have liked my professors to show me something about their research. How they did it and I mean, all of them, from mathematicians to physiologists or psychologists, I think that that would be great because you could see a lot of different things." (UG, Students)

In that sense, both the student and researcher participants remarked that the role of mentors who can include students in research is crucial. A good mentor or supervisor can make a significant difference, not only in the quality of the conducted research but in the student's long-term engagement in research activities.

"I think I am not prepared to do it alone. But if I have some mentor or someone who would lead me and guide me, I think I can do this. And good research. I know it's hard to do something the first time (. . .) and to build it from scratch." (UNIST, Students)

Our participants observed four necessary improvements to curricula: research methodology education, combined with practical work, short-term research-related employment opportunities, and high-quality mentorship. While methodology education relates to a structural problem in curricula, practical work, mentorship, and paid research internships can be combined into one "package" for students or smaller research groups, improving IDR and students' perspectives of research overall.

3.2.3. Subtheme 3: Projects, Internships, and International Exchanges Increase Students' Career Opportunities

Student participation in internship programs or research projects can be a great starting point for long-term research inclusion. Participants offered that universities should actively engage students in research and organise networks that students can use themselves to find research and internship opportunities, both domestically and in other countries.

"We don't know about internships opportunities in other cities or (. . .) countries. In my opinion, I cannot find a network that could provide me with a total view about which laboratory I can send my application to. So that is just one very small issue to me." (UBO, Students)

Our participants thought that international exchange programs should be potentiated as they give students the opportunity to develop their research skills and function autonomously.

"But it's also linked, because the students I mentioned, after they went abroad at the bachelor level, they came back here for their master level and in fact, they really did improve (. . .) following their BSc year in a system where they were asked to be much more autonomous because, at the master level, you're asked to be more autonomous, but ultimately they learn one year in advance about autonomy, in fact." (UBO, Researchers/Staff)

To stimulate students, participants suggested research positions should be opened at universities, so students could see the benefits of engaging in research. If there are no opportunities for a research career, most students will be demotivated to participate.

"So, let's start (. . .) in an ideal world to create some kind of jobs not so deep in research, but (. . .) one year to prove you like [doing research] or you feel comfortable (. . .) later, you can go on with your thesis." (UCA, Researchers/Staff)

Participants found that the same steps can be applied to include students in IAC. The organization of seminars or similar networking opportunities can lead to long-term benefits for students, and potential future employment.

"For example, through seminars financed by the university, of course, when we can meet people, make contacts, make ourselves known (. . .), perhaps [an] exchange where companies can look. Look for us and we can look for them, and I will say this is for getting a job, but also for the access (...)" (UCA, Students)

The greatest benefit of IAC to the participants is the increase in student employability. Connecting students to companies early on should be an example of good practice for all European universities.

"I think that's one of the strong points of the French education system, actually, is the insistence on work placement all the way through. It's much more common here than certainly in the U.K. and some of our European partners as well." (UBO, Researchers/Staff)

We found that internship programs at industry partners, international exchanges, or positions in research projects can increase student involvement in IAC and IDR. However, a prerequisite for their effectiveness is clear communication networks that can be used autonomously by interested students. An expected result of organising such programs could be higher student employability and higher enrolment trends in research careers and research-oriented programs.

3.3. Theme 3: Enhancing the Social Impact of Research—Delimitations between Academia and Society and Ways of Overcoming Them

Participants from the researcher focus groups and the student focus groups noticed a lack of social impact of research. This social impact was a result of the publication models present in research and in the communication methods of disseminating results and "acting" as researchers in society. Researchers and students also suggested solutions to this problem in "translating" research for society to understand, fostering "open science" for sharing knowledge, and "useful" science for applying research to real-world problems. This resulted in the creation of two associated subthemes: (1) barriers in publication models and communication methods, and (2) research "translation", "open science", and "useful science" as methods for disseminating research in society.

3.3.1. Subtheme 1: Differing Publication Models and Communication methods Prevent Research from Reaching Society

Researchers primarily attributed the lack of social impact to the publication model fostered by HEIs, which is not meant for the general populace either due to the specificity of the scientific language, or the lack of access to published research:

> *"When you write a publication, it is for a given public. (. . .) you are using a given level of vocabulary. And of course, when you take out the paper outside this community, it could not be [disseminated] successfully because you have made certain assumptions about the background people should have."* (UBO, Researchers/Staff)

This "delimitation" between society and academia was enhanced by the constant perception of the academic "ivory tower", as participants noticed that society still does not have an idea of what researchers do. Moreover, the constant use of scientific jargon enhances the perception that researchers are patronizing society.

> *"We cannot patronise people out there just because we live (. . .) in an ivory tower, we really need to be careful."* (UM, Researchers/Staff)

Our participants found that research must be socially impactful, especially as it is funded by the European public itself. Making research accessible through clear, non-scientific communication can be the first step towards achieving this.

3.3.2. Subtheme 2: Research "Translation", "Open Science", and "Useful Science" as Methods for Disseminating Research in Society

Certain participants noted some ways of overcoming this issue. Two main methods were suggested: a change in the way research is disseminated among the populace through "translating research", and the creation of new communication methods for educating society about research results.

> *"So maybe an idea [could be] to try to boost or facilitate (. . .) having better communication channels and more reliable and trustworthy information."* (UG, Researchers/Staff)

Similarly, participants in the student focus groups noticed the need for disseminating research among the general population. Two terms often came up in relation to research dissemination: open science, which was seen as a way of making research available and understandable for everyone, and useful science, which was related to making research results have an impact on society and policymakers. In terms of open science, IDR was thought to be especially useful in making a difference in society.

> *"(. . .) make useful science, and, of course, try to reach population with the science, try to solve real day-by-day problems (. . .) for example, if we work individually from a single department, we won't be able to solve these real people's problems."* (UCA, Students)

This was likewise related to the practical application of IDR to real-life problems in society, which was thought to be of higher value than regular research. IDR was also seen as more "contemporary".

> *"(. . .) interdisciplinary research seems to be a more modern kind of the way [where] everything's heading . . . everything seems more and more interdisciplinary in everyday discussions. And, you know, we're starting to have discussions which are intercultural and interdisciplinary in general life."* (UBO, Students)

Our study participants noted that socially impactful research not only affects the public and policymakers, but also the students' and researchers' willingness to engage in research. Making "open science", with data and results being available and understandable to the general public, should be a key initiative at universities and at (inter)national levels.

4. Discussion

The results of this study suggest that both researchers and students believe that, although interdisciplinarity can increase the impact of their work, employability, and society in general, existing regulations, terminology discrepancies, and time consumption in collaborations possibly alienate HEIs from interdisciplinarity. Academic background differences, traditional HEI structures, the lack of communication channels, and ineffective bureaucracy impede both students and researchers from collaborating with scientists from other disciplines and with non-academic partners. While students were inhibited by a lack of research practice and methodology education, researchers were stymied by IDR-specific inertia not visible in single-discipline projects, IDR validation by HEIs, and its lack of impact on their career advancement. Despite these barriers and differences in the perception of interdisciplinarity, both students and researchers agreed on its benefits to science, with students seeing it as significant for their future careers. The students observed joint classes, accessible research facilities, open days, and databases of research laboratories that enrol students, databases of students and experts interested in research, and databases of potential employers and employees could facilitate IDR and IAC. According to our student participants, these factors could bridge the knowledge gap they feel prevents genuine interdisciplinarity.

4.1. Increasing Interdisciplinary and Industry-Academia Collaborations among Researchers and Academic Staff

Interdisciplinary approaches might also benefit experienced researchers. Several researcher participants saw interdisciplinarity as necessary for their research, or as a natural approach to a research problem. Broadening focus towards other disciplines can boost academic advancements, as researchers who expand their careers to other disciplines are more likely to have a higher scientific impact, despite risking decreased productivity [72–74]. However, participants stressed that such efforts were often slowed by a lack of institutional support, complicated bureaucracy, and non-existent communication channels. Simply organizing multidisciplinary institutions is not a segue towards interdisciplinary collaborations, as our participants noticed the differences between interdisciplinarity and multidisciplinarity lie in "true" exchanges between disciplines. Studies have shown that active top-down interventions are key to moving from multidisciplinarity to interdisciplinarity and creating novel collaborations [75], especially in bridging the barriers of hiring, tenure, and promotion, which are still entrenched in single-discipline structures [27]. The solutions proposed by our participants mainly relied on HEIs creating cross-departmental or cross-university seminars or similar collaboration-focused platforms, and on the formation of new research positions for ECRs. Similarly, pre-emptive interdisciplinary education integrated into curricula was proposed, as single-discipline education was seen as limiting for future researchers, since it contributes to the isolation of departments and faculties from one another. In that sense, interdisciplinarity can be seen as an additional tool for bolstering professional adaptability and employability.

For our participants, equally significant in this regard is the validation of IDR by HEIs. They noted that interdisciplinary projects do not necessarily result in publications, but traditional HEI outcome measures hardly consider other outputs as valid. Participants also worried about the scientific impact of IDR, which is a significant criterion for obtaining tenure at HEIs. Despite the rise in the number of interdisciplinary journals, most universities typically recognize single-discipline publications, especially in high-impact, well-cited journals, which could provide issues to researchers publishing IDR [20]. Studies on the citation of interdisciplinary papers vary in their result, suggesting either that proximal IDR (between different, but proximal disciplines) has higher impact [34], while others relate it to distal IDR [35,36]. However, other studies suggest that IDR outcomes should be evaluated through a mixture of quantitative and qualitative metrics [76]. Participants also related the publication issues to the difference in the researcher's academic background, as different disciplines have different publication metrics and expectations. This was related to the final publishing output—some disciplines value journal publication, while others rely on conferences for dissemination. Our participants observed the same issues with IAC, which are confirmed by current literature [39–41]. HEIs should work to recognize this problem, and to solve it by revising the criteria for career advancement, employment, and researcher evaluation to promote interdisciplinary approaches of any kind. For non-academic collaborations, the participants noted a similar revision in criteria for rating outcomes is required.

Moreover, the human factor, mostly connected by our participant to a researcher's "ego", can also be a factor slowing or preventing valuable collaboration. Participants observed that researchers often have misguided expectations from other disciplines, and that differences in academic backgrounds can cause conflicts at early stages of interdisciplinary projects. Strategically planning research teams and setting goals before research begins can help annul this problem [37]. To achieve this, Jacob [30] lists some key characteristics for assembling an IDR team, such as "leadership and management", "effective communication", and "clarity of a shared vision", among others. This agrees with the views of our participants, who believe setting clear boundaries, goals, and establishing respectful communication are prerequisites for IDR.

Researcher participants likewise stressed the funding issues IDR faces stemming from an overall lack of funding for interdisciplinary projects, or a lack of understanding from funders and other stakeholders in evaluating IDR. Participants also noted that committees reviewing project applications often consist of reviewers who are not prepared to look outside of the scope of their discipline, which risks misevaluation of the project's originality and content. Research on ID funding only partially confirms such stances. While interdisciplinary projects are often less successful when initially applying for funding [33], researchers conducting such projects obtain more funding at later stages of their career [77]. Such funding could be important for IDR teams, as it would mean autonomy from the host institution [78] and, thus, independence in creating new collaborations. Institutions could also create separate calls for funding for interdisciplinary researchers, along with interdisciplinary-focused review committees. This would also annul the possibility of interdisciplinarity being a buzzword for obtaining better evaluations for grant applications, something our participants noted as a significant problem when applying for research funds.

On the other hand, participants noted that funds were easier to obtain within the boundaries of IAC, but that this funding method often conflicted either with HEI bureaucracy or the concept of publicly funded HEIs. These barriers were additionally reaffirmed by "issues of trust" between HEIs and industry, and participants believed HEIs should work more to establish themselves as trustworthy "brands". Even when such gaps were bridged, some researcher participants believed that a difference in goals and outcomes (such as publication) between academia and industry were seen as irreconcilable. However, IAC were thought by our participants to bring new methods, research problems, and knowledge to HEIs, along with an opportunity to work on original research problems which could not be necessarily observed from a HEI standpoint alone. Such problems were previously observed in recent literature reviews, which suggested that the creation of comprehensive sector-specific policy, pre-establishment of research plans and goals, and an increased focus on bi-directional knowledge transfer can make such collaborations more successful [39,41]. Our research participants had concrete suggestions towards solving these issues, but a HEI-driven intervention was thought to be necessary, as participants felt less enabled to form collaborations on their own.

4.2. Involving Students in Interdisciplinary Research and Industry-Academia Collaborations—Barriers and Possible Strategies

Our participants expressed the opinion that interdisciplinary approaches are becoming more and more common in all disciplines. In fact, most student participants saw interdisciplinarity as the future of research and considered it to be an important factor for the future of their careers. IDR was also thought to have increased social and "real-life" impact when compared to single-discipline research, and our participants saw it as "useful science". Novel trends prove such opinions to be correct. The number of IDR projects has grown over time [79], and interdisciplinary approaches have shown the ability to generate more high-impact science [80,81]. The Horizon Europe 2021–2024 strategic plan outlined the need for more cross-discipline collaboration and the diffusion of new knowledge into industries, especially aimed at innovation for sustainability [19]. If such trends continue, it is a given that interdisciplinarity and sustainability will drive further research and that students will need to be prepared for the new academic reality in advance.

Our participants noticed a lack of interdisciplinary degrees, courses, platforms, or projects that would allow students to engage in interdisciplinarity. They also observed a lack of communication channels through which students could engage researchers from other disciplines. This was enhanced by the difficulty of gathering knowledge from multiple disciplines, and by miscommunication issues due to differences in academic backgrounds. Considering the increasing number of interdisciplinary programmes and degrees [30], this finding points to a lack of implementation of interdisciplinarity in practice. Due to its higher expected significance in the future, viable solutions for interdisciplinary courses need to be implemented at all levels of higher education. Rethinking HEI structures and programmes through an interdisciplinary perspective by implementing courses and projects can be beneficial for achieving sustainability [82–84], and students exposed to interdisciplinarity have shown an increased proclivity for innovation, despite the difficulties associated with balancing between disciplines [85]. Such courses and programmes should provide the students with "communication skills", "high-order cognitive skills", and knowledge of disciplines and interdisciplinarity, all while balancing with discipline-specific content [86]. According to our study participants, introducing such programmes at lower levels of education (pre-university and undergraduate) could help develop critical thinking and autonomy among students, which are necessary for research to occur and prosper. Moreover, it could prepare them for the "real" aspects of research, such as unexpected or non-satisfactory research results, and could bridge the observed "communication gap" between disciplines and with researchers.

Similarly, traditional, single-discipline HEI structures and miscommunication problems due to single-discipline academic backgrounds were significant barriers to students' willingness to take part in IDR. This is a frequent problem mentioned in the literature on interdisciplinary education [16,20,32], despite the increase in IDR among graduate students [30]. Firstly, the implementation of courses and projects could be a good tool in overcoming the SD barrier. A top-down approach through policymaking, creating internal and external HEI partnerships, granting department leaders more autonomy in developing educational programmes, or even giving departments "co-ownership" of courses and curricula can also be efficient [29,32]. Secondly, creating employment and career opportunities for ECRs willing to engage in IDR is paramount, as our participants observed that single-discipline researchers still have a higher chance of being employed by HEIs than interdisciplinary researchers do. This is a common occurrence at most universities [27] and can discourage students from participating in any type of research. Our participants suggested that HEIs should create such employment opportunities "not so deep in research" such as project assistant positions or internships for a limited time (e.g., a year), which would offer students the possibility of being mentored for future research careers and long-term employment.

Participants also pointed out the role of mentorship in creating research opportunities in general. A good mentor was seen as a critical factor for the inclusion of students into research and could offer them a place in his/her own research projects. They were seen by the student participants both as "guides" for conducting research, and as mediators for facilitating IDR among students and bridging communication gaps. However, participants also noticed that due to time constraints, academic staff and researchers from other disciplines had insufficient time for such activities. These issues were especially prominent for participants who took part in exchanges, internships, or short-term research collaborations, where researchers were additionally constrained by the length of the programme. Other research on interdisciplinarity found time to be an issue as well, both for students and mentors [20,29]. To stimulate both university professors and researchers, HEIs could take into consideration the time constraints IDR takes and could offer better stimulation and rewards for them to engage in ID activities, separate from the traditional single-discipline approaches [20]. The participants also expressed the need for more "open days", during which tenured staff or researchers could show students what "real" research entails. Similarly, participants believed that HEIs could organise "platforms" where students could contact senior researchers from other disciplines with enquiries about problems or offers of collaboration.

Additionally, strengthening international relations can help prepare students for IDR and research in general. Participants observed that exchange and internship opportunities in other countries can help students develop autonomy, critical thinking, and research skills. Prerequisites to such activities, which our participants find lacking, are established international connections between HEIs and non-academic partners and the accessibility of information on such connections to students. Most participants were eager to engage in international collaborations and exchanges but expressed worry at miscommunication due to language and cultural differences. Extensive growth in international student mobilities and the related research offer policymakers a good insight into potential activities for facilitating international collaborations [87]. The recent literature has recognized many of the same problems as our participants and suggests concrete strategies, such as the creation of "international offices" dedicated to incoming exchange students, which can help students accommodate and adapt to new cultural surroundings [88]. The internationalization of educational programmes through exchanges can also help HEIs move towards achieving SDGs, including those of quality education [89]. For researchers, international research collaborations and international funding for projects can help increase citation and research impact [90,91], which can have a positive effect on career advancements and further funding applications.

A lack of research methodology education and practices on all education levels was observed by most participants, and an introduction of such courses could stimulate them to join or better prepare them for research. In the field of biomedicine, research methodology education has shown a positive impact on students' understanding of research, evidence, and critical thinking, and their opinion on science, while science writing workshops have shown a positive effect on publication outcomes [92–94]. However, these studies focus only on SD education. Creating an interdisciplinary methodology course could be a challenge, but even creating general research methodology courses inside the traditional, single-discipline curricula could be a step in the right direction for our participants. To be interesting to students, the participants suggested that such courses must also include practical aspects and opportunities for implementation, the latter being especially important in the context of making a "social impact". IDR was seen by the student participants as critical in solving complex "real-world" problems, which made it especially attractive. This is especially true for environmental sciences, where IDR and sustainability are closely related [27]. A good example of research methodology education for students inside the SEA-EU alliance is the University of Split overlay journal *ST-OPEN*. This journal focuses on publishing student theses as original research articles after a rigorous peer-review process and translation into English, all the time fostering an "author-friendly" policy aimed at improving student theses [95,96]. Through the process, it offers students a real-world experience of publishing an article, and likely their first insight into the world of scientific research.

Our participants observed similar barriers to the inclusion of students in IAC. Although a conflict between the goals of industry and research was noted by student participants, collaborations between universities and industry were seen as beneficial for student employability. A step towards this goal can be taken by organizing courses and projects run jointly by universities and industrial partners, which can increase student employability competencies [38]. However, while such efforts can be facilitated by the diversity of departments at HEIs and interdisciplinary approaches, they can conflict with the contemporary structures and goals at publicly owned universities, as well as research-oriented curricula [38]. Participants also observed that such collaborations were dependent on a supervisor's personal experience. Our findings on this topic are in line with a recent literature synthesis, which found prior experience of individuals at the university level to be "one of the strongest predictors of university-industry collaboration" [67]. This phenomenon also extends to the ideas of knowledge transfer and TT [97]. If a supervisor or a mentor was unavailable, the student participants noticed that "platforms" containing contacts of HEI-friendly companies could offer them a chance to contact industry stakeholders for employment or internship opportunities. Alternatively, a platform with lists of students willing to work in industry could be organised so that partners in the industry can pick a student who fits their needs. In the context of available research on IAC and TT, the concepts of "entrepreneurial networks" and "entrepreneurial ecosystems" are closely related to the creation of such platforms [12].

However, alternatives to traditional, project-based collaborations also exist. In business schools, these include "entrepreneurial education", or systematic preparations of students for careers in industry through courses and practices [12]. Other research suggests the need for a "shift from the main focus from HEIs external stakeholders towards internal stakeholders—educators and students"—in order to create an encompassing entrepreneurial education across multiple disciplines [98]. Certain studies have suggested that to truly foster IAC, HEIs should establish "science-based entrepreneurship education" to foster TT and truly embed industry in science, and vice versa [9]; this type of education is also closely related to interdisciplinarity. Our study found that a cross-section between IDR and IAC exists in their real-world applicability. In fact, student participants found that the application of research to real-world problems encourages their participation. The concept of "science-based entrepreneurship education" offers an inroad towards creating applicable science [9] and could help students and HEIs cross the bridge between academia and industry. Moreover, students are increasingly aware of the importance of entrepreneurial education to both their careers and society in general, and its relation to sustainable development [82,99]. IDR can also be beneficial in that regard, mending the dichotomy between industry and academia [12], which was significant to our participants.

4.3. Research and Social Impact

A common theme among both the researchers, academic staff, and the students was the necessary increase in the social impact of research. All participants, to a varied extent, expressed that most research has little to no impact on society and policymakers and that the perception of the academic "ivory tower" persists among the general population. They called for the introduction of "open science", "research translation", and "useful science". An example of good practice was "transforming" or "translating" research publications into shorter texts usable by the general population. These calls for "useful", socially impactful science were observed by other researchers [100]. For our participants, this approach was critical in making science more attractive to both researchers and students and could help alleviate the mistrust between society and academia.

5. Conclusions

Our study found that, even though IDR has become "ingrained" in many disciplines in practice, significant barriers remain, mostly related to traditional discipline-oriented education and rigid HEI structures. The active top-down facilitation of ID activities through increased funding, the creation of research positions and ID-focused platforms and changes in evaluation and promotion criteria for researchers can, among others, help create and improve IDR at universities. This top-down approach will also ease involving students in IDR. To facilitate student research initiatives, comprehensive methodology education must be introduced at all HEI levels, and platforms created for students to communicate between disciplines and with researchers. To ease IDR for both researchers and students, traditional HEI structures and bureaucratic barriers need to be broken down. Similar strategies can be employed for IAC; however, our participants noticed a dichotomy between the goals the industry and academia have. Certain disciplines, however, were thought to be inherently connected to the industry and project- or internship-based collaborations were seen as beneficial for student employability. These results can be useful for policymakers at HEIs and HEI-related institutions to inform the creation of new collaborations within an ID and international context, and to create new opportunities for students and researchers to work with non-academic partners.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14159306/s1, Table S1: Topic guide for researchers/academic staff; Table S2: Topic guide for students; Table S3: Themes developed from qualitative analysis and participant statements.

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