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Competences for the future: Trends and challenges

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Competences for the future: Trends and challenges

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Tuning Journal for Higher Education (TJHE), Tuning Journal in short, is an international peer-reviewed journal publishing in English original research studies and reviews in all aspects of competence-based, student-centred, and outcome-oriented education reforms at university level across the globe. It is a joint initiative of the University of Deusto (Spain) and the University of Groningen (The Netherlands) that is run by the Tuning International Academy (http://tuningacademy.org/): an international meeting point for fostering innovative teaching, learning, and research in higher education.

The main goal of the Journal is to promote quality research into the 'Tuning Methodology' for designing, implementing, and assessing context-sensitive degree programmes and to subject the tools developed during Tuning projects and other educational projects to full academic scrutiny and debate among students, teachers, policy makers, administrators, and academics across societies, cultures, professions, and academic disciplines. To this end, the Journal invites applications for thematic issues, conference proceedings or monographs from all stakeholders. Guidelines for the preparation and submission of manuscripts are appended to this Issue and available at the web of the Journal: http://www.tuningjournal.org/

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Competences for the future: Trends and challenges

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Editorial

Competences for the future: Trends and challenges

Editorial

Mary Gobbi
Editor

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As I write this reflection at the beginning of May, it is timely to think of our colleagues around the world who are in the heat of the pandemic, particularly colleagues in India. In November I wrote: 'where might we be for the next edition in May 2021? Who knows? Will we be emerging from the metaphorical winter of discontent[1] into the 'summer sun' armed with our jabs, swabs, and test results?

Some of us do see the 'summer sun' with light at the end of the tunnel- albeit no one knows for how long. Others remain in the grip of overwhelming infections surrounded by death, disease, and associated poverty. The importance of collegiality and equity cannot be underestimated as COVID 19 is a one world problem. John Donne's words come to mind:

> no man is an island (entire of itself). A person requires the company and support of others and society as a whole in order to thrive.[2]

As Donne argued, the connections between the individual, (man or woman), a supportive network and broader society are necessary to thrive. However, in our era of pandemic, what we observe is more fundamental; the company and support of others and society *is necessary to survive*. The negative consequences of isolation, mask wearing and reductions in social and physical activity has its impact on young and old alike. We now have evidence that young children are behind in their social skills and language development due to less social contact, but more crucially contact behind masks. Here lie challenges for our education systems, not just now, but as different age groups feed into Higher Education carrying the experiences of COVID with them.

The editorial team would like to thank those authors who rose to the challenge of generating papers related to the pandemic. We are delighted to

[1] Adapted from: William Shakespeare, *Richard III*, Act 1, Scene 1.
[2] From: *Devotions upon Emergent Occasions*, John Donne 1624.

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announce that for the next two editions at least, November 2021 and May 2022, there will be a special section of the Journal focusing on the implications for Higher Education of the pandemic. We are honoured to welcome Professor Anca Greere as the Section Editor for this section of the Journal.

Anca is Director of the European Master's Programme in Translation Studies and Terminology at the Babes-Bolyai University in Romania. In this capacity, she is an active member of the European Master's in Translation Network coordinated by the European Commission. Anca is an international quality assurance expert who has broad ranging experience of collaborating with governments, agencies and higher education institutions to design and successfully implement quality assurance approaches which support a positive educational experience for all stakeholders and contribute to quality cultures across educational sectors. In this capacity, she has collaborated with multiple QA agencies in the UK (QAA and BAC), Estonia, Georgia, Lithuania, Romania, Saudi Arabia and Jamaica.

For a chance to be published in the November 2021 edition we require submissions before the end of June 2021. Further details on this Special Section are found on the Journal web site (https://tuningjournal.org/announcement).

This edition comprises a small group of papers, largely due to the impact of the pandemic upon the availability of reviewers. However, we have many in the pipeline for a bumper edition in November. I would like to take this opportunity to genuinely thank our reviewers who, amidst the business of their daily academic life and home circumstances, have helped us by reviewing an amazing range of papers from numerous disciplines and countries.

Wishing all our readers a summer of promise in the North and a quiet Winter in the South free from fresh waves of pandemic. Happy writing folks!

The editorial team

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Introduction

Competences for the future: Trends and challenges

Introduction

Mary Gobbi
Editor

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When analysing the four papers that comprise this edition of the Journal, there were some quite similar themes, albeit with different perspectives. Essentially, the papers are considering different types of competences, their evolution over time, and the future needs of the work force in specific disciplines. What is fascinating is the emergence of a discourse of competences that is paradoxically extending and becoming more sophisticated on the one hand, yet on the other is confused, locally situated and difficult to define. We find competences being described as global, generic, scientific, technical, and associated with workplace learning. The geography of the papers provides a hierarchy of analysis from an international and global perspective to a sub-regional analysis of five countries (Europe), country based (Chile) and programme specific (The Netherlands). Matched with this, two papers focus on the scientific and technical domains.

First, Beneitone and Yarosh in "*Measuring global competences in the framework of internationalized curricula"* review the generic competences associated with graduates as potential actors in a global context. The article is a meta-analysis of data from eight Tuning studies across four continents (Europe, Latin America, Africa, and Asia) with a sample of one hundred countries. The data were collected between 2005 and 2018 and comprised the ratings of different stakeholder groups with respect to the importance and achievement of eleven global (generic) competences as judged by over 71,000 graduates, employers, students, and academics. Despite the inevitable limitation of comparing studies separated by time, this study enables cross -country as well as constituent stakeholder comparisons. At the heart of the paper is the thorny question as to the elements of competence that are necessary to be a 'global citizen'. The authors acknowledge the problems not only of definition, but also the process of determining such competences and the level to which they should be achieved. Some readers will find the methods section of particular interest. Here the authors outline how they

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addressed the hierarchical challenge mentioned earlier. Namely, how to address the fact that an individual academic department may be 'nested' within an institution which itself is located within a country, or pan-national grouping. From the analysis of the eleven competences reviewed, the authors were able to conclude that these competences are deemed important across the countries studied, irrespective of differences in weighting in specific regions. Clearly further work in other regions is necessary and an in depth understanding of what the competences mean in context.

From the global we move to country -specific in the second paper from Sandoval and Ormazábal, "*The Generic skills challenge for higher education institutions: Experience of public universities in Chile"*. Here we see situated development of the discourse(s) of generic competences emerging from a cacophony of terms, local histories and stakeholder engagement where there was no standard or language in common. This paper provides a foundation from which subsequent students of Chilean High Education can trace the emergence of generic skills within the public universities. The paper charts the impact of internal and external forces upon Chile, the engagement with Tuning Latin America and the 'curricula innovation' process of government-funded development in the first decade of the century. The empirical work involved documentary analysis and structured interviews with eighteen teaching directors in public universities in Chile. The findings revealed the plethora of terms used to refer to generic skills, some particular to the university concerned. One hundred and seventeen generic competences were identified, although these could often be clustered into domains. Over time these competences have been reduced in number, integrated, or refined. The authors also noted that the interpretation of the meaning of the competences occurs at institutional level.

An interesting feature of the Chilean system is something called the 'institutional seal' which does not have the status of a generic competence but is rather a cluster of generic competences which together represent the mission, identity, or training characteristic of the institution. The 'seal' is a relatively new development. Perhaps it is a modern form of 'socialisation' to enable the student to graduate with the externally recognised features of the institution. A surprising 50% of the generic competences elicited in the study were judged to contribute to the institutional seal. These competences are emphasised within the intra and extracurricular activities of the institution. As the authors point out, these institutional seal competences are difficult to assess. The characteristic features of the 'seal competences' vary from region to region in contrast to those found in urban areas like the capital city. The regional demographics and environment provide nuances to the seal

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competences reflecting the characteristics of the place and the student population. The paper explores the pedagogical strategies used to develop the generic competences.

From this detailed account of the emergence, development, and refinement of the competences at institutional level, what is apparent is that there remains no uniform or unifying standard of generic competences at national level.

Reading this paper after Beneitone and Yarosh, it is evident that undocumented local interpretations of what a given competence *means,* can undermine comparative studies within and between countries. Another interesting observation from Sandoval and Ormazábal is the recognition that the speed of change in the scientific, technological, and social arenas has implications for the generic skills required for employability. This latter point forms part of the focus of the third paper by Cesco, Zara, De Toni, Lugloi, Evans and Orzes, "*The future challenges of scientific and technical higher education"*.

The paper by Cesco, Zara, De Toni, Lugloi, Evans and Orzes—a study conducted in Europe—considers the extent to which the programmes under investigation (1) prepare students for their professional future; and (2) can meet the needs of current and future students. The context is technical-scientific study programmes. The authors commence by reviewing the future demands upon the labour market with respect to scientific and technical development and skills. They draw attention not only to the speed of development, but also the impact of digital technologies, new materials, and new processes like Artificial Intelligence upon several employment sectors. Looking to the future and the educational needs of Generation Z and Alpha to remain employable at graduation and subsequently through lifelong learning. The analysis was conducted using the then top five European Countries with respect to their Gross Domestic Product (Germany, UK, France, Italy, and Spain). The definitions used in this paper for competences and skills are technical, methodological, personal, and social (the latter three being part of so called 'soft' skills).

What emerges from their detailed analysis of a range of data sources is that in some subject areas there are insufficient numbers of graduates (at bachelor level or masters level or both) to fulfil the needs of specific sectors within the labour market. In some cases, the gender balances needs addressing. The paper provides a helpful review of the respective educational needs and preferences of the different generations of students in Higher Education. A strength of the paper is the comprehensive analysis of modern educational techniques and technologies that may best help current and future students.

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When discussing the challenge of digitally enabled teaching tools, the authors remind us that not only are we dealing with the *'characteristics, needs and expectations of the different generations of students*' we are also managing with different generational differences amongst faculty and staff. In the latter part of the paper, the authors discuss the various structural relationships between the Higher Education (HE) systems and the Vocational Higher Education and Training (VET) sector. Here there is room for improvement with respect to the interface between HE and VET, the location of courses and their need to provide lifelong learning programmes for the labour market.

Our next paper from The Netherlands is a case study that focuses specifically on the design and delivery of a Science, Business and Policy (SBP) track within a multidisciplinary, work -based learning (WBL) Masters programme that enabled students to have a subsequent career in science and policy. In Grooters, Zaal, Menno and Gerkema "*Science, Business, and Policy: A long-term reflection on multidisciplinary work-based learning in a master's track for societal integration of Science"* we discover how a structured workplace learning package embedded within the programme improved student grades in theory and practice. At the heart of the Dutch Higher Education system is the parallel system of research -knowledge based universities (like the study institution) and universities of applied sciences that focus more upon professional practical knowledge and skills. Hence this programme was specifically designed to enable science, business, and policy students to learn together in an applied manner through engaging in a combination of theoretical modules, project work and work placements. Students are provided with preparatory courses and workshops that enable to apply for their work placements, developing independence, writing, leadership, and employability skills.

Readers interested in a 'how to do this paper' that offers a logical, coherent, rationale, evidenced and critical reflection upon events will find this paper extremely helpful. The strength of the paper is that it draws together both the theory and practice associated with general pedagogic literature, research on work-based learning, application of science to society, multidisciplinary education, and the engagement of stakeholders in the design of the programme. The authors propose a theoretical model of design and identified six critical success factors to the curriculum design and implementation. To investigate any impact of the reports the students wrote, a Directed Content Analysis was undertaken. This analysis included data on the students (origins, attrition), work placement setting, (type, location), tools use and grades and subsequent employability. Research continues on the evaluation of this project.

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So, once more we explore the debates, concerns and nuances associated with defining competences and skills. We are reminded about the complexity of competences and skills and how difficult they can be to define, measure and evaluate their relevance and impact.

Some lyrics from the Sound of Music song 'Maria' come to mind, so please forgive my paraphrasing but-

How do you solve a problem like a competence?
How do you catch a couple and pin them down?
How do you find the words that really say it?
A seal! A verb!! A noun!

Many a skill you know you'd like to show them
Many a thing we ought to understand.

But how do we make them stay and -listen to what we say?
How do you keep a soft skill on the sand?

How do you solve a problem like a competence?
How do you hold a value in your hand?

(*Music* by Richard Rodgers with lyrics written by Oscar Hammerstein II. 1959)

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Articles

A Comparative analysis of global competences within the framework of internationalized curricula

Pablo Beneitone and Maria Yarosh*

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Abstract: An agreement seems to exist that graduates must be equipped with competences required to act successfully and appropriately in a global context. Many authors have proposed lists of competences that could form part of such a graduate profile which must be taken into account when designing internationalized curricula. However, merely listing of a competence does not guarantee that students develop it to the level expected by society. The present article reports on a meta-study based on eight Tuning studies. This meta-study compared the findings across the eight Tuning studies in terms of the different stakeholder groups' ratings of importance and achievement of 11 global competences – generic competences valued by over 71,000 graduates, employers, students and academics in more than 100 countries and across four continents (Europe, Latin America, Africa and Asia). The contribution of the meta-study presented consists in offering a possibility to identify commonalities and differences among the perceptions of the four key stakeholder groups, not only across all the individual studies but also at the level of the four continents – something never accomplished until the present date. In addition, it will help identify the competences that might require particular attention of curriculum designers and teaching teams for students to develop these competences to the level perceived as optimal in

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different regions of the world. Future research questions are identified with the aim to enrich and validate or fine-tune these initial findings and compensate for the limitations related to the general timeline of the 8 individual Tuning studies that the meta-study built on.

Keywords: Academics; achievement; Africa; Asia; EAHEA; employers; Europe; generic competences; global competences; graduates; importance; internationalization of curriculum; Latin America; students.

I. Introduction

The development of graduates as global citizens is now claimed in the policies of many universities,[1,2] but such an education for global citizenship demands a holistic redesign of degree programmes.[3] Curriculum design – at least in a competence-based, student-centred paradigm – involves a series of decisions about what a graduate should be able to know, do, and be. Accordingly, thinking about future graduates implies considering the local needs and the national context where the degrees are conceived, but also accepting that the University is responsible for preparing future citizens and professionals who will live and work in a global environment.[4] They must also ensure students develop desired competences to the necessary level, regardless of the mode of the programme delivery, and of whether international mobility can be undertaken by students or not.

As previous research shows, this broad aim has by now become part of the of discourse, but a number of questions require further exploration and work before this goal can become reality and university

[1] Betty Leask, *Internationalizing the Curriculum* (New York and London: Routledge, 2015).

[2] Valerie Clifford and Martin Haigh, "Graduate attributes for global citizenship," in *Moving towards internationalisation of the curriculum for global citizenship in higher education*, ed. Valerie Clifford and Catherine Montgomery (Oxford: OCSLD, Oxford Brookes University, 2011), 93–118.

[3] Valerie Clifford and Catherine Montgomery, "Designing an internationationalised curriculum for higher education: embracing the local and the global citizen," *Higher Education Research & Development*, 36 no. 6 (2017): 1138-1151, https://doi.org/10.1080/07294360.2017.1296413.

[4] Kathleen Lilley, Michelle Barker and Neil Harris, "Educating global citizens: a good 'idea' or an organisational practice?," *Higher Education Research & Development* 34, no. 5 (2015): 957-971, doi: 10.1080/07294360.2015.1011089.

curricula will, indeed, permit students to develop the necessary competences.[5,6,7,8]

Two concrete obstacles that both scholars and practitioners of higher education (HE) must overcome are, firstly, a lack of consensus on competences that will make graduates ready for life and work in a globalized world, and secondly, a lack of data on how well the existing programmes are featuring in this respect. In relation to the first aspect, it appears promising that at least some of the recent studies show that there is a considerable overlap between the competences identified as important for (local) employers and those that have been identified as necessary to become global citizens.[9,10,11] On the other hand, Schech, Kelton, Carati and Kingsmill raise a highly relevant question of the extent to which a certain configuration of competences identified as desirable for all graduates in one part of the world can indeed compare to what graduates might need if they happen to work outside their country or continent.[12] Borkovic, Nicolacopoulos, Horey and Fortune, in turn, call for further research on the success of current programmes in helping students develop such competences, research that can give concrete guidance, for example, about which of the competences should be addressed in more detail.[13] Additionally, Sarkar, Overton, Thompson and Rayner suggest that

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[5] Shinead Borkovic, Toula Nicolacopouloa, Dell Horey and Tracy Fortune, "Students positioned as global citizens in Australian and New Zealand universities: A discourse analysis," *Higher Education Research & Development* 39, no. 6 (2020): 1106-1121. https://doi: 10.1080/07294360.2020.1712677.

[6] Robert Wagenaar, *Reform! TUNING the Modernisation Process of Higher Education in Europe. A Blueprint for Student-Centred Learning* (Bilbao and Groningen, 2019).

[7] Lilley, Barker and Harris, "Educating global citizens", 957-971.

[8] Sussane Schech, Maryanne Kelton, Colin Carati, and Verity Kingsmill, "Simulating the global workplace for graduate employability," *Higher Education Research & Development* 36, no. 7 (2017): 1476-1489. doi: 10.1080/07294360.2017.1325856.

[9] Beverly Oliver and Trina Jorre de St Jorre, "Graduate attributes for 2020 and beyond: recommendations for Australian higher education providers," *Higher Education Research & Development* 37, no. 4 (2018): 821-836. doi: 10.1080/07294360.2018.1446415.

[10] Stefan Hajkowicz, Andrew Reeson, Lachlan Rudd, Alexandra Bratanova, Leonie Hodgers, Claire Mason and Naomi Boughen, *Tomorrow's digitally enabled workforce: Megatrends and scenarios for jobs and employment in Australia over the coming twenty years* (Brisbane: CSIRO, 2016).

[11] James Arvanitakis and David Hornsby, *Universities, the citizen scholar and the future of higher education* (Basingstoke: Palgrave Macmillan, 2016).

[12] Schech, Kelton, Carati and Kingsmill, "Simulating the global workplace", 1476-1489.

[13] Borkovic, Nicolacopouloa, Horey and Fortune, "Students positioned as global citizens", 1106-1121.

academics' perspectives might have not been prominent enough and that their opinions should be studied and given no lesser attention than the views of students, graduates and employers.[14]

Since the beginning of the 21st century, academics from over a hundred countries – through eight independent but interrelated Tuning studies[15,16,17,18,19,20,21,22] – have been involved in a debate with a focus on what competences should be aimed at in order to prepare students to work and life in the increasingly culturally-complex world, regardless of the students' future professional occupation. This article undertakes a detailed analysis of 11 competences which appeared in all the eight Tuning studies and might, therefore, be considered global. There are two main research questions behind this article:

- How relevant these 11 global competences are for different stakeholders in a diverse and large number of countries;

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[14] Mahbub Sarkar, Tina Overton, Christopher D. Thompson, C. and Gerry Rayner, "Academics' perspectives of the teaching and development of generic employability skills in science curricula," *Higher Education Research & Development* 39, no. 2 (2020): 346-361. doi: 10.1080/07294360.2019.1664998

[15] Pablo Beneitone and Edurne Bartolomé, "Global generic competences with local ownership: a comparative study from the perspective of graduates in four world regions," *Tuning Journal for Higher Education* 1, no. 2 (May 2014): 303-334. https://doi.org/10.18543/tjhe-1(2)-2014.

[16] Artur Demchuk, Ivan Dyukarev, Evgeniya Karavaeva, Pablo Beneitone, Julia González and Robert Wagenaar, *Towards Comparability of Higher Education Programmes. Information Review* (Bilbao: University of Deusto, 2013).

[17] Pablo Beneitone, César Esquetini, Julia González, Maida Marty Maleta, Gabriela Siufi and Robert Wagenaar, *Reflections on and Outlook for Higher Education in Latin America* (Bilbao: University of Deusto, 2007).

[18] Charles Awono Onana, Olusola Bandele Oyewole, Damtew Teferra, Pablo Beneitone, Julia González and Robert Wagenaar, *Tuning and Harmonisation of Higher Education: The African Experience* (Bilbao: University of Deusto, 2014).

[19] Anne Katherine Isaacs, Ahahdon Najmitdinov and Aimen Tasbolat. *TUCAHEA Tuning Central Asia Towards a Central Asian Higher Education Area*. Pisa: Dedalo edizione, 2016.

[20] Robert Wagenaar, Arlene Gilpin and Pablo Beneitone, *Tuning in China. An EU-China Feasibility Study into the Modernisation of Higher Education* (Bilbao: Universidad de Deusto, 2015).

[21] Richard Jugar and Ouda Teda Ena, *Reference Points for the Design and Delivery of Degree Programmes in Teacher Education. Tuning South East Asia* (Bilbao: University of Deusto, 2019).

[22] Tuning India Project 2018. Accessed 17 October 2020. https://tuningindia.org/wp-content/uploads/T-India-2GM-Booklet-web.pdf.

- How well today's HE programmes – in different parts of the world and from the point of view of different stakeholders – are catering for the actual development of these 11 global competences (actual achievement versus perceived need to focus on these competences), and, thus, allowing graduates to effectively become global citizens and professionals.

With this, the authors seek to contribute to the discussion about which competences might need to be prioritized and paid more attention to by HE institutions in order to achieve curriculum internationalization. Furthermore, they should prepare graduates to perform globally, especially in the 'post-Covid world', where physical international mobility and extra-curricular activities cannot be taken for granted and expected to 'compensate' for lack of curricular attention to key non-subject-specific elements of desired graduate profiles.

II. Methodology of the meta-study

The present article analyses the data collected in eight Tuning studies across four continents between 2005 and 2018 (see Table 1 for an overview of the study scopes and samples). These studies were undertaken by academics from public and private universities who worked together in international curriculum development projects and sought, among other goals, to identify those generic competences (GCs) that were most valued by academics, graduates, students and employers of a particular region and those GCs which were in need of greater attention in HE programmes offered in the region in question. The focus was on identifying competences that any graduate in the region needs in order to be prepared to work and live in a culturally-diverse and changing world. Named 'generic competences', these were seen as complementary to those (subject-specific) competences that prepare students to join the chosen professional community; GCs were perceive as relevant for all students and graduates, regardless of the specialization/particular HE programme pursued.

Each study had a different geographical scope, but used the same methodology for initial identification of such competences, and consulting stakeholders on perceived importance and perceived achievement of each competence.

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All in all, 432 public and private universities were involved in these Tuning studies, and conducted consultations with stakeholders to collect data. Care was taken to bring together respondents from different education and occupation sectors so as to also represent multiple disciplinary perspectives. Participating universities were in charge of selecting different stakeholders in a random sample (71,000 respondents in total), provided that the following criteria were met:

- academics were to teach at each university participating in the study (17,023 in total),
- employers were to come from among those identified as usually hiring or likely to hire graduates of each university participating in the study (9,387 in total)
- students were to be enrolled in one of the last years of a degree programme offered by each participating university in the study (26,207 in total)
- graduates were to come from those who successfully completed a degree programme offered by each participating university, within five years before the date of the consultation (18,477 in total).

Students, graduates and academics had to come from the same programmes selected to represent viewpoints of different academic disciplines/sectors. Employers invited were those known or likely to hire graduates of the same programmes.

Stakeholders were consulted, with the use of an online questionnaire, about importance and perceived achievement of the GCs from a list agreed upon by inter-institutional and inter-disciplinary teams of academics who formed the core group of each Tuning study. Each respondent was required to:

a) indicate the importance of each of the competences in the list for ensuring that graduates could join and successfully navigate the world of employment and play the role expected of persons with HE degree in society. The same 4-point scale was used in all of the studies to rate the importance of the competences in the list (4 – strong, 3 – considerable, 2 – weak, 1 – none).
b) indicate the extent to which he/she perceived each of the competences to be achieved by students enrolled in currently existing degree programmes by the end of the (first-cycle) HE degree programmes; again, the same 4-point scale was used in all the studies (4 – strong, 3 – considerable, 2 – weak, 1 – none).

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The meta-study compared the findings across the eight Tuning studies in terms of the different stakeholder groups' ratings of importance and achievement of 11 GCs. Those that were identified as key in all the studies could, therefore, be considered global competences:

1. Ability to apply knowledge in practice
2. Creativity
3. Problem solving
4. Critical and self-critical abilities
5. Capacity for abstract thinking, analysis and synthesis
6. Capacity to learn actively
7. Teamwork
8. Commitment to the conservation of the environment
9. Social responsibility and civic awareness
10. Oral and written communication
11. Appreciation of and respect for diversity and multiculturality

The meta-study presented in this article compared the different stakeholders' perspectives at two levels: the level of individual Tuning studies (8) and the level of the regions (4), grouping the eight studies according to the continent where they were conducted. The following four regions were distinguished:

- European Higher Education Area (EHEA) – Europe 2008 and Russia 2011 studies;
- Latin America – Latin America 2005/2012 study;
- Africa – Africa 2012/2015 study; and
- Asia – Central Asia 2013, China 2015, South-East Asia 2017 and India 2018 studies.

The eight studies and their findings are comparable for three key reasons. Firstly, they all worked with the same operational definition of the concept of (generic) competences. Secondly, the questionnaires administered in the eight studies – during the consultations – collected data about the same variables and using the same scale across all regions. Thirdly, the same four respondent groups were consulted in every study and these groups were defined in the same way. One of the main differences is the way in which the different regions and stakeholders weight these competences in curriculum, and the next section shares the findings of such meta-study, competence by competence.

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Table 1

Overview of the eight Tuning studies in terms of their geographical scope and the samples

Region	Study	Number of respondents (Academics – AA; Employers – EE; Students – SS; Graduates – GG)				
		AA	EE	SS	GG	Total
EHEA (European Higher Education Area)	**Europe[23] (2008[24])**	2,041	879	2,219	1,948	7,087
	Russia (2011[25])	2,220	1,856	2,479	2,414	8,969
LATIN AMERICA	**Latin America[26] (2005 & 2012[27])**	5,453	2,278	11,215	8,462	27,408
AFRICA	**Africa[28] (2012 & 2015[29])**	1,813	1,311	2,183	1,790	7,107

[23] The study included data from Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kosovo, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Republic of Macedonia, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland, United Kingdom and Ukraine.

[24] For the complete study, see Beneitone and Bartolomé, "Global generic competences", 303-334.

[25] For the complete study, see Demchuk, Dyukarev, Karavaeva, Beneitone, González and Wagenaar, *Towards Comparability of Higher Education Programmes"*.

[26] The studies included data from Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.,

[27] Two consultations were conducted in Latin America (2005 and 2012), with the 2005 list used verbatim in 2012 to collect data from stakeholders from additional Subject Areas. For more information, see Beneitone, Esquetini, González, Marty Maleta, Siufi and Wagenaar, *Reflections on and Outlook for*.

[28] The studies included data from Algeria, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Democratic Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Ethiopia, Eritrea, Gabon, Gambia, Ghana, Kenya, Lesotho, Libya, Madagascar, Malawi, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Somalia, South Africa, South Sudan, Sudan, Tanzania, Tunisia, Uganda, Zambia and Zimbabwe.

[29] Two consultations were conducted in Africa (2012 and 2015) – the 2012 list was used again in 2015 to collect data from stakeholders from additional Subject Areas. For more information, see Awono Onana, Bandele Oyewole, Teferra, Beneitone, González and Wagenaar, *Tuning and Harmonisation*.

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Region	Study	Number of respondents (Academics – AA; Employers – EE; Students – SS; Graduates – GG)				
		AA	EE	SS	GG	Total
ASIA	**Central Asia[30] (2013[31])**	3,562	1,226	4,766	1,634	11,188
	China (2015[32])	307	482	474	485	1,748
	South East Asia[33] (2017[34])	961	837	1,835	1,105	4,738
	India (2018[35])	666	518	1,036	639	2,859

Total: 103 countries; 71,094 respondents (17,023 Academics; 9,387 Employers; 26,207 Students; & 18,477 Graduates).

Note: The left-most column indicates the region of the study (four continents represented). The second column shows specific studies and years of consultations, while the next five columns indicate the numbers of respondents – by category.

III. Analysis of the global competences

This section introduces the main results analysed in terms of the different regional and stakeholder groups' perceptions of the importance and achievement of the 11 global competences. Table 2 (below) summarized the results of the eight consultations in relation to each competence in terms of Importance (IMP) and Achievement (ACH). It shows the rating given by the different stakeholders (Academics; Employers; Students; Graduates) and refers to the means for each competence on the 1 to 4 scale (1 – none, 2 – weak, 3 – considerable, 4 – strong). Each competence was rated by the four stakeholder groups in terms of importance and achievement, so there are two results for each competence.

[30] The study included data from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

[31] For the complete study, see Isaacs, Najmitdinov, and Tasbolat. *TUCAHEA*.

[32] For the complete study, see Wagenaar, Gilpin and Beneitone, *Tuning in China*.

[33] The study included data from Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand and Vietnam.

[34] For the complete study, see Jugar and Teda Ena, *Reference Points*.

[35] For the complete study, see Tuning India Project 2018, accessed 17 October 2020, https://tuningindia.org/wp-content/uploads/T-India-2GM-Booklet-web.pdf.

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In terms of analysis, two aspects must be considered. First, a general overview of the average of each of the global competences helps us have a clear picture of the levels of two main variables, importance and achievement; and second, the gap between both variables introduces more elements for reflection. In order to proceed with the first step of the analysis, we need to take into account that the data collected in the surveys in the eight Tuning studies has a hierarchical structure, in the sense that individuals are nested in universities, and universities are nested in countries, forming a hierarchical structure. A multilevel approach[36] has been taken here, as the data, due to this clustering effect, are not fully independent from each other and the results cannot be considered as completely random. To cope with this hierarchically structured data, an intra-class correlation needed to be calculated to check whether the differences between the aggregate units were high enough, and, therefore, to use the multilevel method for this purpose.

All the calculations of the data at university and country level were derived using this method as it takes into account, and controls for, the structure of data clustering. An additional advantage is that multilevel models allow the simultaneous appreciation of the difference at the individual respondent level and at the aggregate (university, subject area) level.

Once the clustering effect in the sample had been neutralized for comparison purposes, the mean scores for every global competence were computed in terms of the importance of the competence for the respondent, and in terms of the level of achievement the respondents believed had been reached for this particular competence in their context. The results of each individual Tuning study were shown in a comparative perspective in Table 2, in relation to the two main variables and the means. More detailed information about standard deviation and other more specific and concrete statistical data can be found in each of the eight Tuning studies separately.

A relevant aspect to stress is that Table 2 introduces a second level of analysis, which is the gap between the two variables (importance and achievement). For each competence, in relation to the perception of each stakeholder in each study, the gap that exists can be inferred. This gap is a central element that nourishes the whole reflection on global competences, their level of importance and the distance perceived by different stakeholders in different contexts, in terms of achievement. Table 2 allows to visualize the means of values assigned to both variables, but not directly the gap. This requires a much more detailed analysis that will be presented in the next

[36] Anthony S. Bryk and Stephen W. Raudenbusch, *Hierarchical Linear Models: Applications and Data Analysis Methods* (Sage: Newbury Park, CA, 1992).

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Table 2

Comparative Rating of Importance and Achievement of 11 Global Competences per region, study and stakeholder

GLOBAL COMPETENCE	Variable	EHEA								LATIN AMERICA				AFRICA				ASIA															
		EUROPE				RUSSIA												CENTRAL ASIA				CHINA				SOUTH EAST ASIA				INDIA			
		AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG	AA	EE	SS	GG
Ability to apply knowledge in practice	IMP.	3.62	3.68	3.69	3.67	3.76	3.7	3.68	3.66	3.67	3.62	3.59	3.63	3.39	3.4	3.32	3.4	3.54	3.62	3.57	3.54	3.49	3.44	3.52	3.56	3.75	3.78	3.72	3.63	3.56	3.61	3.58	3.54
	ACH.	2.67	2.54	2.55	2.53	3	2.98	3.01	2.99	2.63	2.76	2.84	2.83	2.69	2.77	2.78	2.78	3.05	3	3.04	3.07	2.57	2.58	2.42	2.51	3.08	3.13	3.09	3.16	2.87	2.76	2.8	2.82
Creativity	IMP.	3.44	3.38	3.36	3.36	3.43	3.35	3.42	3.36	3.38	3.28	3.36	3.27	3.26	3.29	3.31	3.25	3.47	3.45	3.48	3.49	3.34	3.34	3.29	3.37	3.67	3.67	3.61	3.56	3.35	3.33	3.37	3.35
	ACH.	2.32	2.44	2.4	2.42	2.69	2.72	2.8	2.78	2.34	2.51	2.51	2.47	2.42	2.53	2.59	2.57	2.97	2.86	2.97	2.96	2.45	2.57	2.48	2.55	2.93	2.97	3.02	3.11	2.65	2.5	2.72	2.76
Problem solving	IMP.	3.61	3.58	3.59	3.6	3.62	3.63	3.57	3.59	3.74	3.69	3.69	3.73	3.48	3.52	3.42	3.48	3.49	3.49	3.5	3.55	3.51	3.6	3.53	3.61	3.67	3.64	3.59	3.59	3.47	3.47	3.44	3.41
	ACH.	2.65	2.69	2.83	2.78	2.86	2.85	3.04	3.08	2.76	2.87	2.94	2.98	2.56	2.67	2.7	2.72	2.98	2.89	2.93	3	2.6	2.73	2.42	2.65	3.01	3.04	3.03	3.12	2.81	2.67	2.81	2.93
Critical and self critical abilities	IMP.	3.41	3.28	3.34	3.39	3.24	3.23	3.28	3.26	3.55	3.52	3.56	3.51	3.53	3.54	3.48	3.52	3.49	3.49	3.5	3.55	2.95	2.92	3.04	2.95	3.67	3.67	3.61	3.56	3.44	3.4	3.39	3.43
	ACH.	2.47	2.48	2.84	2.62	2.6	2.66	2.88	2.93	2.55	2.71	2.72	2.72	2.56	2.69	2.77	2.7	2.98	2.89	2.93	3	2.26	2.37	2.44	2.36	2.93	2.97	3.02	3.11	2.79	2.65	2.75	2.84
Capacity for abstract thinking, analysis and synthesis	IMP.	3.73	3.46	3.48	3.5	3.49	3.35	3.33	3.37	3.75	3.66	3.62	3.68	3.65	3.6	3.47	3.52	3.47	3.41	3.47	3.49	3.64	3.61	3.57	3.6	3.67	3.67	3.61	3.56	3.44	3.4	3.39	3.43
	ACH.	2.94	2.85	2.89	2.96	2.85	2.81	2.9	2.99	2.86	2.96	2.95	2.96	2.73	2.85	2.76	2.88	2.97	2.85	2.91	2.93	2.92	2.85	2.71	2.81	2.93	2.97	3.02	3.11	2.79	2.65	2.75	2.84
Capacity to learn actively	IMP.	3.6	3.49	3.46	3.48	3.62	3.48	3.42	3.44	3.77	3.71	3.71	3.75	3.39	3.41	3.34	3.37	3.52	3.59	3.56	3.56	3.56	3.55	3.52	3.58	3.71	3.68	3.58	3.6	3.58	3.53	3.37	3.53
	ACH.	2.78	2.89	2.89	2.92	2.83	2.94	3.09	3.07	2.81	2.93	2.89	2.98	2.61	2.76	2.78	2.8	3.03	2.87	3.03	3.08	2.76	2.88	2.87	2.91	2.99	3.04	3.02	3.17	2.88	2.8	2.83	2.94
Teamwork	IMP.	3.25	3.51	3.43	3.41	3.41	3.58	3.43	3.43	3.56	3.48	3.48	3.49	3.48	3.46	3.37	3.44	3.39	3.46	3.46	3.47	3.36	3.48	3.4	3.51	3.68	3.67	3.55	3.57	3.48	3.57	3.42	3.48
	ACH.	2.61	2.73	2.89	2.75	2.85	2.92	3.02	2.99	2.56	2.73	2.79	2.8	2.59	2.69	2.76	2.7	2.96	2.92	2.98	2.99	2.62	2.76	2.81	2.78	2.92	3.02	2.98	3.09	2.91	2.79	3	3.04
Commitment to the conservation of the environment	IMP.	2.8	2.9	2.97	2.85	3.04	3.07	3.02	2.99	3.77	3.71	3.74	3.73	3.61	3.58	3.57	3.62	3.37	3.4	3.42	3.39	3.03	3.06	3.12	3.04	3.62	3.61	3.5	3.53	3.21	3.21	3.18	3.22
	ACH.	2.2	2.39	2.23	2.21	2.44	2.67	2.66	2.67	2.84	2.9	2.87	2.86	2.7	2.76	2.75	2.8	2.97	2.85	2.99	2.94	2.35	2.54	2.56	2.49	2.87	2.98	2.96	3.06	2.62	2.54	2.75	2.75
Social responsibility and civic awareness	IMP.	2.97	3.01	2.99	2.91	3.28	3.26	3.14	3.14	3.52	3.47	3.43	3.41	3.45	3.43	3.36	3.38	3.37	3.39	3.35	3.39	3.29	3.26	3.37	3.27	3.62	3.61	3.5	3.53	3.5	3.53	3.44	3.45
	ACH.	2.35	2.45	2.4	2.34	2.68	2.83	2.87	2.85	2.68	2.78	2.86	2.8	2.55	2.62	2.68	2.64	2.94	2.86	2.89	2.95	2.49	2.75	2.77	2.7	2.87	2.98	2.96	3.06	2.85	2.78	2.95	2.93
Oral and written communication	IMP.	3.6	3.51	3.48	3.49	3.57	3.54	3.52	3.5	3.6	3.65	3.59	3.66	3.46	3.51	3.47	3.53	3.33	3.43	3.36	3.44	3.39	3.34	3.3	3.35	3.67	3.66	3.59	3.61	3.57	3.61	3.44	3.47
	ACH.	2.79	2.8	2.84	2.8	2.96	3.02	3.16	3.11	2.83	2.93	3.12	3.14	2.61	2.69	2.8	2.75	2.91	2.89	2.93	2.93	2.79	2.81	2.78	2.79	2.98	3.04	3.2	3.14	2.97	2.8	2.99	3.05
Appreciation of and respect for diversity and multiculturality	IMP.	3	2.97	3.07	2.99	3.21	3.14	3.14	3.14	3.41	3.33	3.39	3.31	3.2	3.2	3.17	3.19	3.37	3.39	3.4	3.38	2.91	2.87	2.97	2.93	3.43	3.42	3.45	3.39	3.23	3.31	3.3	3.37
	ACH.	2.48	2.58	2.63	2.57	2.79	2.81	2.9	2.87	2.6	2.72	2.78	2.7	2.34	2.49	2.46	2.51	2.96	2.96	2.96	2.93	2.41	2.59	2.7	2.67	2.81	2.92	2.98	3.03	2.76	2.63	2.95	3

Note: The left-most column lists the Global Competences. For each, the data for Importance (IMP) and Achievement (ACH) are provided region- and study-wise. Within each study the mean for each stakeholder group is indicated: Academics (AA), Employers (EE), Students (SS), and Graduates (GG).

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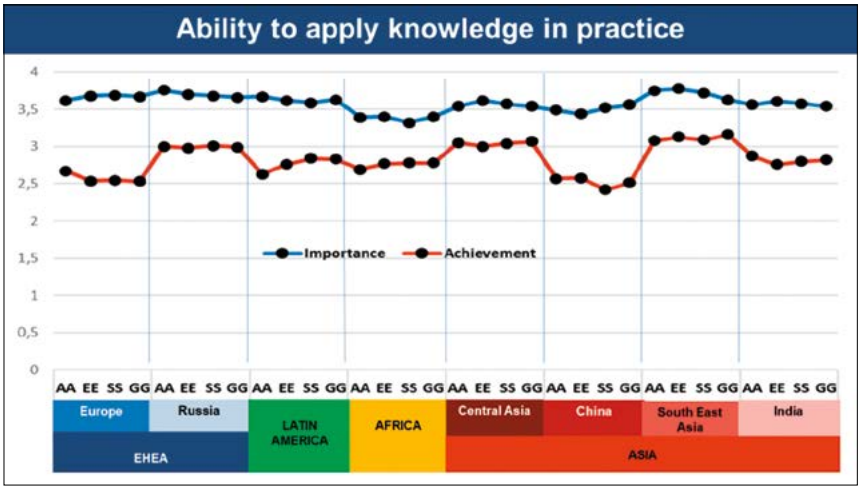
eleven sub-sections that introduce one global competence after another and bring together the outputs of the meta-study, pointing out similarities and differences in competence ratings at the level of regions (EHEA, Latin America, Africa and Asia), zones/studies (see 'Study' column of Table 1) and stakeholder groups. The graphics (1 to 11) display the findings for each global competence across studies and regions.

Both Table 2 and Graphics 1–11 show that the mean for achievement is in all cases lower than the mean for importance: there is a gap between the desired and the actual level of competence development. This gap between the two variables/means is a crucial factor to consider, and such a gap is of greater concern when the competence in question is rated as a highly important, as all the global competence are. Therefore, each sub-section below looks first at the perceived importance of a given global competence, and next at the gap between its perceived importance and achievement.

III.1. Ability to apply knowledge in practice



Graphic 1

Importance and Achievement Ratings for the 'Ability to apply knowledge in practice' competence across regions, studies and stakeholders

'Ability to apply knowledge in practice' is the competence perceived as the most important of the 11 global competences analysed in this meta-study.

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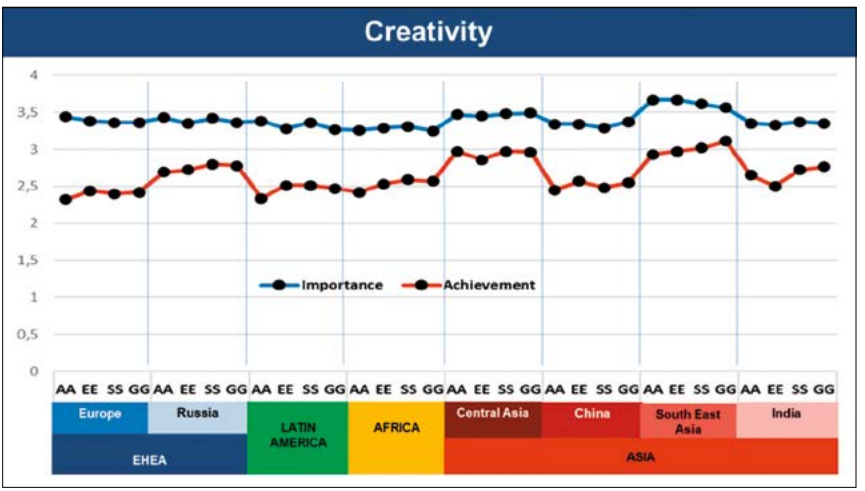
It was rated among the top 5 most important in most of the eight studies and by almost all stakeholders. An exception to this clear global trend is Africa, where it was rated among the last three in order of importance by all four stakeholders.

At global level, there does not appear to exist any clear pattern in terms of the stakeholder groups who tend to value this competence most or least. Employers indicate valuing it more often than any other stakeholder group, while Graduates most often give this competence a lower rating,

In terms of gap, and in comparison with the other 10 global competences, 'Ability to apply knowledge in practice' shows the largest gap values between importance and achievement in the 8 studies. Europe is the zone and EHEA the region that report the greatest gaps (1.09 for Europe and 0.89 for EHEA), while Central Asia is the zone and Africa is the region where the smallest gaps were reported (0.53 for Central Asia and 0.62 for Africa). It is interesting to stress that in Europe, when analysing the values given to the 11 global competences, 'Ability to apply knowledge in practice' appears as the most important, but also the one that shows the greatest gap from the levels of achievement. On the other hand, in Africa, this competence is perceived to be among the 3 least important global competences, but shows the smallest gap in this regional study.

III.2. Creativity



Graphic 2

Importance and Achievement Ratings for the 'Creativity' competence across regions, studies and stakeholders

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If we analyse each of the 8 studies individually, 'Creativity' does not appear among the five (or even six) most important competences in any zone/region and occupies, rather, an intermediate position for the four stakeholders in almost all the studies, with the exception of Latin America and Africa, where it is considered the least important of the 11 global competences. When comparing the eight studies, and in terms of a trend in stakeholder evaluation, in four of the studies it is Academics who value it the most and Graduates the least (in Europe, Russia, Latin America and South-East Asia). Asia as a region and South-East Asia as a zone value this competence the most, while Africa and Latin America are at the opposite extreme. Academics and Employers in South-East Asia give this competence the highest rating (3.67) and Graduates in Africa – with the lowest (3.25).

In terms of the perceived gap, 'Creativity' is the second of the 11 global competences with the widest gap. When analysing the eight studies individually, in four of them (Europe, Russia, China and India) it is perceived as the competence with the biggest gap compared to the other 10 global competences. Academics are the most concerned: in six studies they identified the biggest gap. When looking at the eight studies comparatively in relation to 'Creativity', Latin America is the region with the widest gap. EHEA comes second, but if we look at Europe, the gap reported is even bigger than in Latin America (and Academics in Europe are the group who sees the biggest gap – 1.12). Central Asia reported the smallest gap, which led to Asian region on the whole featuring the lowest gap.

Comparing 'Creativity' with 'Ability to apply knowledge in practice', it is interesting to stress that both are the competences with the largest gaps in all the studies. An interesting difference to highlight is that there is no clear pattern between the most important competence and the one with the largest gap. For example, in Latin America, 'Creativity' appears as the least important with one of the three largest gaps with respect to the 11 global competences, while 'Ability to apply knowledge in practice' is among the three most important and also one with the largest gap. This means that it is not possible to defend a statement that says the greater the importance, the greater the gap with the perception of achievement.

III.3. Problem Solving

'Problem solving' is the competence perceived as the second most important of the 11 global competences analysed in this meta-study. It was rated among the top five most important in six of the studies and by almost all

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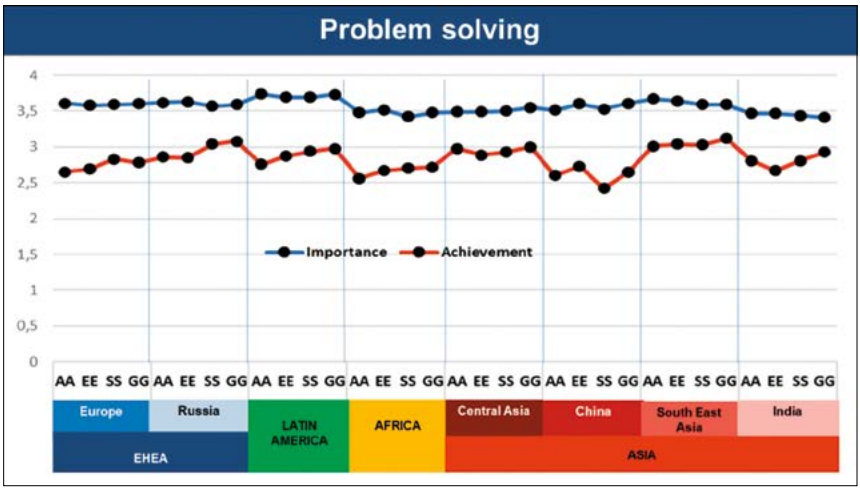

Graphic 3

Importance and Achievement Ratings for the 'Problem solving' competence across regions, studies and stakeholders

stakeholders, and even in the other two studies (India and South East Asia) some of the stakeholders (Students in both studies and Graduates in South East Asia) also rated it among the top five in terms of level of importance.

Academics tend to value this competence more than Graduates or Students, with the exceptions of Central Asia and China. Graduates, in turn, give it more importance than Students in six studies and three regions, with Asia being the exception. Latin American respondents value this competence the most, while Africa as a region and India as a zone feature the lowest average importance ratings.

In terms of the difference between importance and achievement, Employers report a bigger gap than Students or Graduates (with the exception of China), and Academics are more concerned than Students and Graduates in all the regions but for China and Central Asia. Furthermore, the gap reported by Academics is the biggest in two regions (Latin America and Africa) and three studies (Europe, Latin America and Africa), while in further three, those most concerned with achievement are Employers (Russia, Central Asia and India). Graduates, in contrast, are the most satisfied in three studies (Russia, South-East Asia and India) and share this lesser level of concern with Students in Latin America. The region most satisfied with the 'Problem solving' competence development is Asia, with Central Asia in

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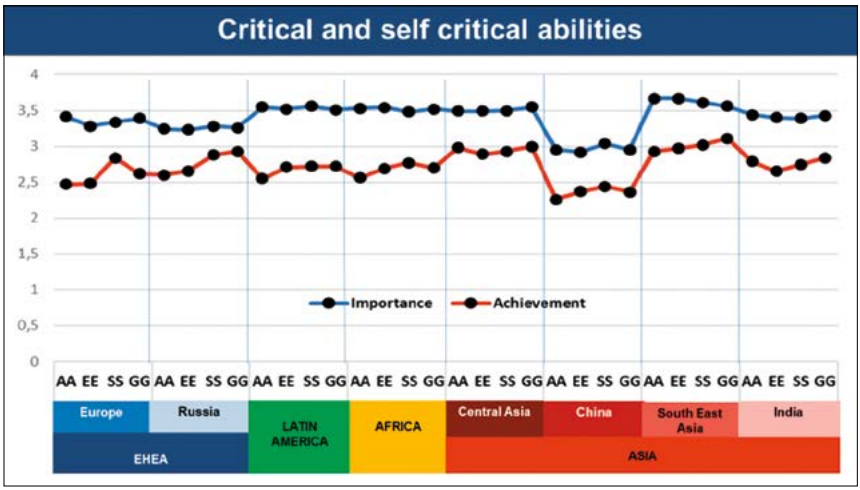
particular being the study with the smallest gap reported. The region that reported the highest gap is Latin America, although the average gap reported is even higher in China, if we look at the level of a single study. Across all studies and stakeholder groups, the range of the gap between perceived importance and achievement is wider than for many other global competences, sharing this specific characteristic with the other two explained above: 'Ability to apply knowledge in practice' and 'Creativity'.

III.4. Critical and self-critical abilities



Graphic 4

Importance and Achievement Ratings for the 'Critical and self-critical abilities' competence across regions, studies and stakeholders

There is a coincidence in two studies (Africa and Central Asia) where all stakeholders value 'Critical and self-critical abilities' among the four most important of the 11 global competences. In China, on the contract, the four groups rated 'Critical and self-critical abilities' as one of the least important in comparison with the others global competences (10th position out of 11).

In terms of comparison of the level of importance among the stakeholders in the meta-study, Academics give it the highest importance compared to the other three groups in three studies; Employers do the opposite in four of the studies. There are, however, also studies where Employers value 'Critical and

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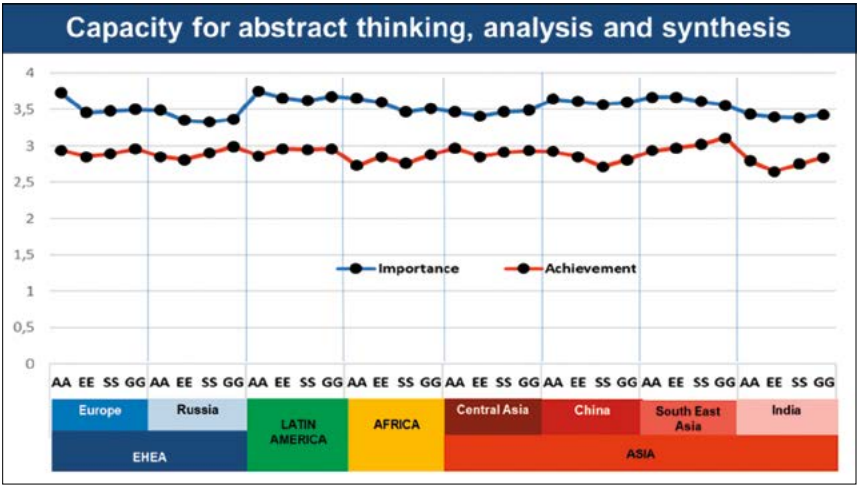
self-critical abilities' more than any other stakeholder group (Africa and South-East Asia) and one study where Students and Graduates (not Academics) are the group to give it the highest importance. Latin America is the region and South-East Asia the zone that value this competence the most. The lowest importance was given in EHEA as a region and China as a study/zone.

As for the gap, Academics reported the biggest gap in six studies (except for Central Asia and India), while Graduates reported the smallest gaps in four studies and the second-smallest gap in the other four. Asia is the region with the lowest perceived gap, while at the level of a single study this was so in Russia. Latin America is the region (and study/zone) in which the average gap reported was the highest.

III.5. Capacity for abstract thinking, analysis and synthesis



Graphic 5

Importance and Achievement Ratings for the 'Capacity for abstract thinking, analysis and synthesis' competence across regions, studies and stakeholders

In three studies (Latin America, Africa and China) all stakeholders value 'Capacity for abstract thinking, analysis and synthesis'among the 4 most important out of the 11 global competences. There are four other studies where some of the stakeholders consider this competence among the five most important, while in India, all four groups rate it among the four least important.

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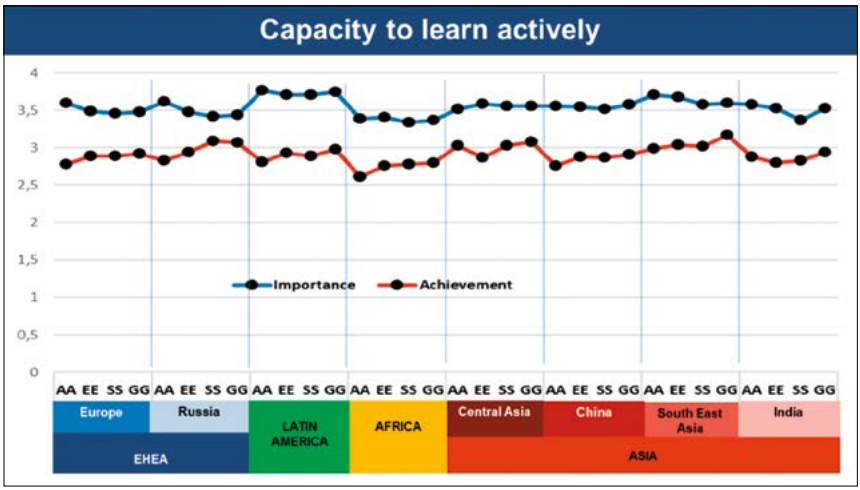
In relation to the perception of importance from the perspective of the stakeholders, there seems to be clear patterns across regions. Academics most often value 'Capacity for abstract thinking, analysis and synthesis' the most (in seven studies) and Students the least (in five studies). The region that values this competence the least is EHEA, with Russia as the zone giving it the lowest average rating. On the other hand, Latin America rated 'Capacity for abstract thinking, analysis and synthesis' the highest, with Academics in Latin America being 'the champions' of this competence (3.75).

In terms of the gap, Graduates most often report the smallest gap (the least gap reported in five studies), while Academics tend to report the highest gap (in four studies). The study that reports the biggest gap is China, while the region with the lowest perceived gap is EHEA.

III.6. Capacity to learn actively



Graphic 6

Importance and Achievement Ratings for the 'Capacity to learn actively' competence across regions, studies and stakeholders

As with 'Ability to apply knowledge in practice' and 'Problem solving', 'Capacity to learn actively' is a competence perceived as one of the most important out of the 11 global competences analysed in this meta-study. It was rated among the top 5 most important by all stakeholder groups in five

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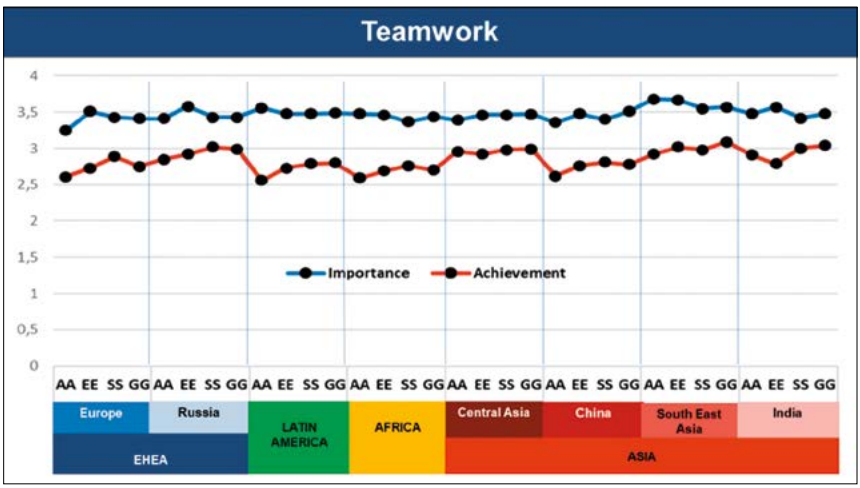
studies, and by some of the stakeholder groups (Academics, Employers and Graduates) in others (India and South East Asia). The case of Africa is an exception, because all African stakeholders rated 'Capacity to learn actively' among the four least important out of the 11 global competences.

If we compare the perception of the different stakeholder across the regions, Academics most often value 'Capacity to learn actively' most (in five studies) and Students tend to value it least (in seven studies). Except for Central Asia, Graduates everywhere value this competence higher than Students. Latin America values 'Capacity to learn actively' the most (with Academics being the 'champions' – 3.77).

In terms of the perceived gap, Academics are the most concerned. In six studies they identified a bigger gap than any other stakeholder group. Students appear less aware of the gap, which might be partly related to their tendency to give 'Capacity to learn actively' somewhat lesser attention.

Latin America as a region reported the widest gap (Academics being the most concerned), while Russia reported the smallest gap (with Students being the least concerned). This led to EHEA on the whole featuring the lowest gap compared to the other three regions.

III.7. Teamwork



Graphic 7

Importance and Achievement Ratings for the 'Teamwork' competence across regions, studies and stakeholders

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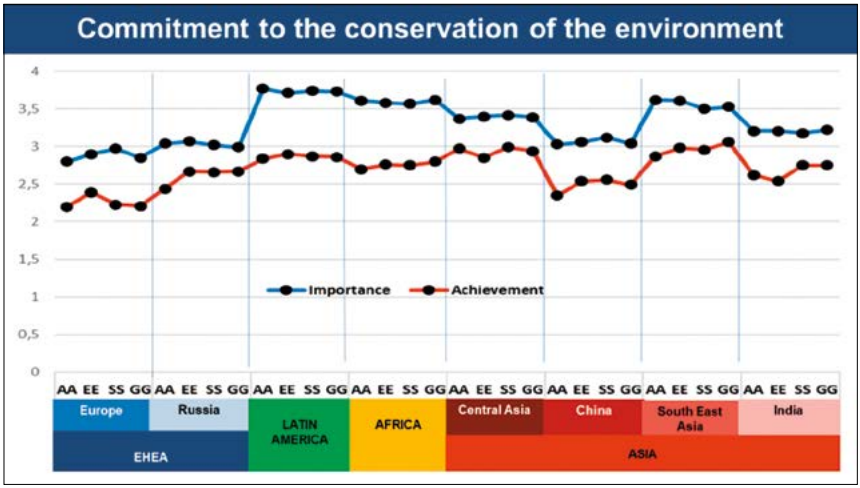
In terms of importance, Students in all the studies value 'Teamwork' less than Graduates and, except Latin America, less than Employers. Academics, in turn, value 'Teamwork' the least in four studies and value it the most in three others. The region where 'Teamwork' is most valued is Latin America, although South-East Asia as a zone values this competence even more highly. The region that values 'Teamwork' the least is EHEA, with Europe as the zone giving it the average lowest rating (although still 3.4 out of 4). Across all stakeholders and studies, Academics in South-East Asia valued 'Teamwork' the highest, and Academics in Europe, the lowest.

In terms of the gap, Students most often report the smallest gap, while Employers and Academics tend to report the highest (Academic in four studies and Employers in the other four). Except for China, Employers everywhere appear more concerned with the level of 'Teamwork' development than Graduates. Latin America reports the biggest gap, Asia and EHEA, the lowest. Finally, Students in Russia see the smallest gap in achievement, while Academics in Latin America rate it the highest.

III.8. Commitment to the conservation of the environment



Graphic 8

Importance and Achievement Ratings for the 'Commitment to the conservation of the environment' competence across regions, studies and stakeholders

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In terms of importance, it can be observed that there are six studies that consider 'Commitment to the conservation of the environment' among the 3 least important global competences for all stakeholders compared to the rest of the competences. On the other hand, in Latin America and Africa, all stakeholders rate 'Commitment to the conservation of the environment' among the 3 most important competences.

Focusing on how the stakeholders rate this competence comparatively across the eight studies, Graduates and Students are the groups that most often value 'Commitment to the conservation of the environment' the highest of the four stakeholder groups and Academics and Employers are those who tend to value it least. At the level of regions, Latin America has the highest average (with Academics valuing it most at 3.77) and EHEA, the lowest (with Academics in Europe ascribing it the lowest importance – 2.80).

In terms of the gap between importance and achievement, Academics were the most concerned. In six studies they identified a bigger gap in 'Commitment to the conservation of the environment' competence development than any other stakeholder group. Employers appear less aware of the gap, which might be partly related to their tendency to give this competence somewhat less attention compared to other stakeholder groups.

Latin America and Africa reported the widest gap between importance and achievement for 'Commitment to the conservation of the environment'. It is interesting to note that, as mentioned above, this competence is at the top of the importance list for all stakeholders in both regions.

III.9. Social responsibility and civic awareness

'Social responsibility and civic awareness' is considered among the least important global competences in seven individual studies for all stakeholders. Only in India did all stakeholders rate it as one of the 5 most important global competences. In relation to the perception of the different stakeholders across the regions and zones, Academics value 'Social responsibility and civic awareness' most in four studies (Russia, Latin America, Africa and South-East Asia), while Students value it the least in five studies (Russia, Africa, Central Asia, South-East Asia and India). Latin America is the region where 'Social responsibility and civic awareness' is valued the most, although South-East Asia as a zone values it even higher. The region that values this competence the least is EHEA (with average for Europe being even below 3 – 2.97).

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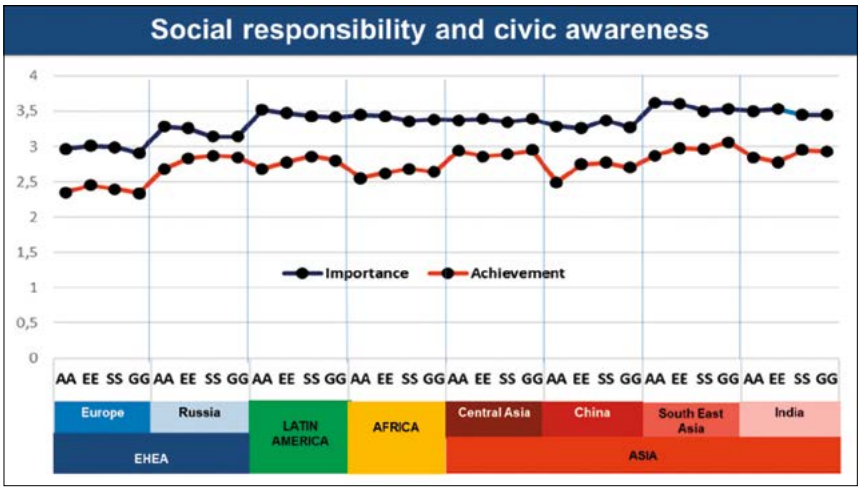

Graphic 9

Importance and Achievement Ratings for the 'Social responsibility and civic awareness' competence across regions, studies and stakeholders

As for the gap between importance and achievement, there is a clear pattern for almost all studies: Academics report the biggest gap (except for Central Asia and India), with the biggest one reported in Africa. Students in four studies report the smallest gap (Russia, Latin America, Africa and India), with the gap reported in Russia being the smallest.

At the level of zones/regions, Africa is the region with the greatest perceived gap and EHEA – with the smallest. Interestingly, EHEA region gave 'Social responsibility and civic awareness' the lowest level of importance, but also reported the smallest gap between desired and actual level of achievement. This implies that even though the competence was not perceived as being of highest importance in the region, stakeholders believe it to be well developed by students by the end of their HE studies.

III.10. Oral and written communication

In terms of importance, it can be observed that Employers in all regions value 'Oral and written communication' more than Students. Furthermore, Students tend to see this competence as less important compared to Graduates (with the exception of Russia). In two regions – Latin America and Africa –

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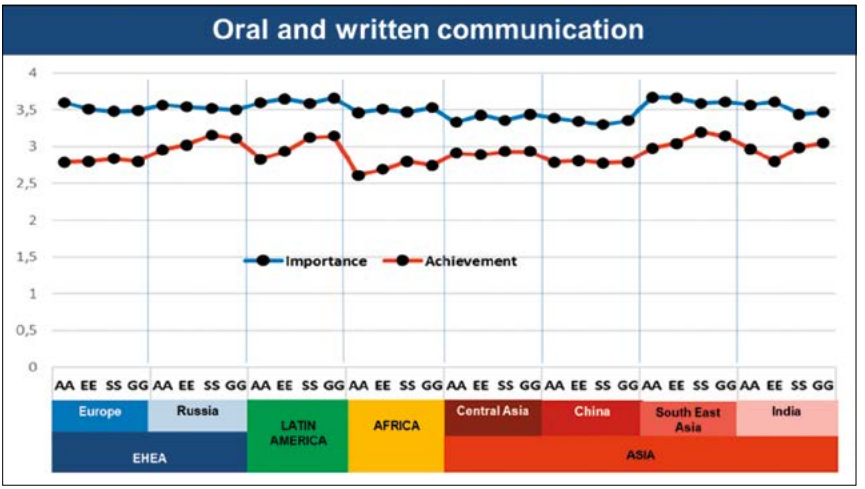
as well as in Central Asia zone, Graduates value 'Oral and written communication' the most. At the level of zones and regions, Latin America is the region which values this competence the most and so is South-East Asia as a zone. Asia, as a whole, is the region that values 'Oral and written communication' less than all the others. Within Asia, China has the lowest average in perceived importance (not only compared to the other Asian studies, but across all the eight studies). Finally, Academics in South-East Asia ascribed the highest value to 'Oral and written communication' (3.67), while Students in China did the opposite (3.30).

As for the gap between desired and actual achievement, in three regions (EHEA, Latin America and Africa) and six studies (adding China and South-East Asia), Academics report the highest difference, while Students report the lowest. In the other two studies – Central Asia and India, Employers report the biggest gap. Additionally, five studies (Europe, Russia, Latin America, Africa and South-East Asia) reveal the same pattern: Academics are concerned with the situation the most, Employers come second, Graduates third and Students the last. Furthermore, in all studies except India, Graduates see a bigger gap than Students, while Employers in all the studies report a bigger gap than Graduates and – with the exception of China – a bigger gap than Students as well. The region that reported the largest gap for 'Oral and



Graphic 10

Importance and Achievement Ratings for the 'Oral and written communication' competence across regions, studies and stakeholders

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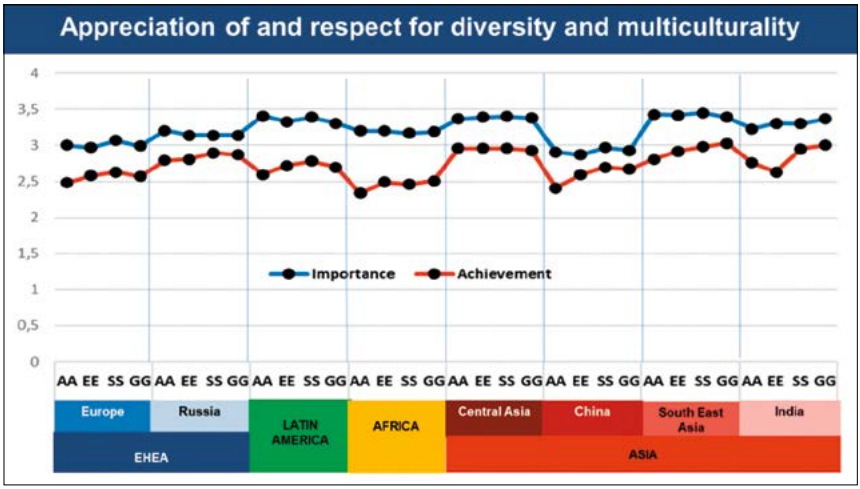
written communication' was Africa (0.78), while the lowest gap was reported in Russia as a zone (0.47) and Asia as a region (0.53).

III.11. Appreciation of and respect for diversity and multiculturality



Graphic 11

Importance and Achievement Ratings for the 'Appreciation of and respect for diversity and multiculturality' competence across regions, studies and stakeholders

'Appreciation of and respect for diversity and multiculturality' is considered one of the least important competences across the eight studies and from the perspective of all the stakeholders in comparison with the other 10 global competences. Latin America is the region where this competence is rated highest across all the stakeholder groups (3.36), although Students in South-East Asia value it even higher (3.45). China as a zone/study and EHEA as a region are at the opposite end, with perceived importance there being the smallest across the four stakeholder groups (although above 2.90 and 3.00 respectively).

As for the gap between perceived importance and achievement, Academics reported the biggest gap in six studies (except for Central Asia and India), while Students reported the smallest gaps in four of the studies, and the second-smallest in three more. EHEA is the region where the gap observed across the

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stakeholder groups is the lowest (0.37; and even lower for Russia as a single study - 0.31). Africa is the region with the highest average gap reported for 'Appreciation of and respect for diversity and multiculturality' (0.74). Finally, Academics in Africa reported the highest gap (0.86), while Students in Russia were the group who perceived the smallest gap (0.24).

IV. Conclusions

One of the main contributions of this comparative meta-study is additional, and stronger, evidence to confirm the importance of the 11 global competences – competences that were considered key elements of the desired graduate profile regardless of the area of studies in 103 countries. Apart from the fact that these competences appear in all the studies and regions, their importance is also consistently rated above 3 (out of 4). In fact, only in four of these competences did some stakeholder groups rate a competence below 3, but never below 2.80. This finding can clearly contribute to the current discussion on the internationalization of the curriculum and of which competences can be considered as 'strong candidates' to be seen as global. This means that by ensuring that students develop these 11 competences to a higher level, any HE programme could, at least partly, be meeting the goal of preparing globally-competent graduates.

It has been observed that there are differences that are visualized in the comparative analysis of each of the 11 global competences in the regions and countries. Here both the level of importance and the gap between the importance and the level of achievement provide very interesting elements for reflection. Variations are observed in terms of regions, but also in terms of the perception of the different stakeholder groups. For example, in the data related to importance, there are competences that show a similar behavior from the point of view of the four stakeholder groups within the same region (e.g. 'Appreciation of and respect for diversity and multiculturality' in Africa, China and South East Asia), and competences where certain stakeholders have a convergent perception, regardless of the region from which they respond (e.g. Students in all the studies valuing 'Teamwork' competence less than Graduates).

When importance and achievement data are compared across the four continents, in six of the eight studies, it is the Academics who clearly perceive the greatest gap between the level of importance and the level of achievement in all the 11 global competences, in comparison with the rest of the stakeholders. Only in Central Asia and India, the biggest differences are

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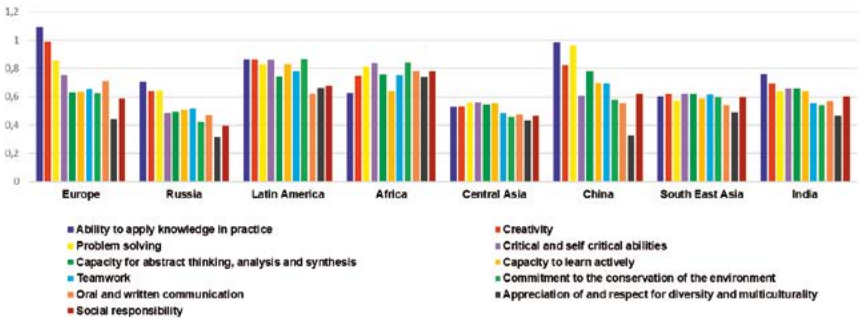
identified by Employers. Regarding the smallest gaps, the trend is not as strong as in the previous cases, although there is a prevalence of Students and Graduates reporting achievement to be very close to importance for the 11 global competences.

When comparing the 11 global competences, it is the 'Appreciation of and respect for diversity and multiculturality' that presents the smallest gap in almost all studies, and 'Ability to apply knowledge in practice' and 'Creativity' are the ones for which the greatest difference between importance and achievement have been reported in almost all regions. The graphic below summarizes the mean of gap (for the four stakeholders) among regions per global competence.



Graphic 12

Comparative gap of each Global Competence by study and region

It is interesting to highlight that Latin America and Africa show the largest and more balanced gaps in almost all of the 11 global competences in comparison with the other regions and studies. On the other hand, and in general terms, Central Asia and Russia seem to be the zones where the gaps in the 11 global competences are the smallest. As it was stressed in the particular analysis of some of the global competences, there are some studies which show a very wide gap in comparison with the others. For example, in a comparative analysis of the 11 global competences, Europe shows largest gap for 'Ability to apply knowledge in practice' and 'Creativity' in the present the meta-study. Furthermore, Latin America has the widest difference between the level of importance and the level of achievement in the eight studies for 'Teamwork', 'Commitment to the conservation of the environment', 'Capacity to learn actively' and 'Critical and self-critical

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abilities'. Africa shows the widest gap in comparison with the other regions and zones in relation to 'Capacity for abstract thinking, analysis and synthesis', 'Social responsibility and civic awareness', 'Oral and written communication' and 'Appreciation of and respect for diversity and multiculturality'. Finally, China has the largest gap for 'Problem solving' in comparison with the other seven studies.

Each competence in itself, and all of them as a whole, seen across regions, open a space for reflection regarding what is lacking in order to bring graduates closer to achieving the desired level of the competence(s) in order to close the gap between the importance and the perceived achievement. This is one of the questions the present meta-study would like to raise by way of suggesting possible future lines of analysis and interpretation.

Two more future research questions are directly linked to the limitations of the present meta-study: some world regions are not covered in this paper and the data analysed were not collected at the same time. In relation to the first aspect, no comparable date has so far been collected in North America (USA and Canada) or Oceania. Collecting data from these regions can assist in confirming whether what is displayed here as potentially global is, indeed, global. The second possible future development involves a new consultation conducted synchronously in all the regions of the world. This will allow us to compare results and perceptions world-wide, without the possible interference of the time factor.

To conclude, focusing of these 11 global competences in a degree programme might be highly instrumental in approaching curriculum internationalization. The research presented, however, has stressed how relevant and necessary it is for HE Institutions to ensure the presence of global competences, not only in curriculum design, but – much more importantly – in implementation: to ensure that graduates indeed develop the global competences. This article shows that there is some reflection and further efforts to be made by HE Institutions in order to close the gap between the desired and actual achievement of these global competences. The meta-study has also highlighted that it is critical to engage different stakeholder groups in reaching this goal and meeting the expectations of the society. All of them are part of a global society and have something to say and contribute to the solution.

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The Generic skills challenge for higher education institutions: Experience of public universities in Chile

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Abstract: In recent decades in Chile, generic skills have been made explicit in the graduation profiles and curricula of all programs of higher education institutions, following global trends that relate to labor market expectations on the employability of graduates. The institutional characteristics, mission, educational model, and institutional seal condition the choice of the generic skills that are developed. There are no current standards for the process of definition of generic skills sets in the various programs for the different universities. The same is true for the modality of implementation for them. The present article has the purpose of contributing to the knowledge of both the definition and implementation of generic skills inside higher education institutions in Chile. This process becomes relevant in the context of the new demands of students and graduates who face additional employment challenges.

Keywords: generic skills; curriculum; generic competences; management education; Chilean universities

I. Introduction

In recent decades in Chile, generic skills have been highlighted and made explicit in the graduation profiles and curricula of virtually all programs of

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higher education institutions, following global trends that relate to labor market expectations on the employability of graduates. The influence of globalization, job insecurity, massification of higher education, and the shift towards a knowledge-based economy are also intervening factors in the concern for the employability of graduates and relevant generic skills.[1] In addition, Chilean educational policies provided resources and incentives for higher education institutions to address training designs based on competences.[2] This process has been framed in an effort of the institutions to differentiate in a strongly competitive higher education market.

The institutional characteristics, mission, educational model, and institutional seal determine the choice of the generic skills that are developed, varying in quantity, levels of achievement, and modalities of curricular implementation. However, there are no studies reviewing the selection and implementation of generic skills in Chilean universities from a comparative perspective.

The purpose of the present article is to contribute to the knowledge of the definitions and modalities of implementation that public institutions have adopted in relation to generic skills. To do so, the process of adaptation of public universities is described and contextualized from both a global and local perspective.

II. Generic skills in higher education

The debate on generic skills in Europe, the USA, Australia, and other countries is already more than three decades old. It is certainly not a new topic of discussion, even when the use of the term "competence" is. In fact, just as Diaz Barriga[3] points out, it is possible to trace the essence of the dichotomy between encyclopedic knowledge and solution-oriented thinking back to the XVII century. Nevertheless, it was only in the XX century, when the schools

[1] Cristina Sin, and Guy Neave, "Employability Deconstructed: Perceptions of Bologna Stakeholders", *Studies in Higher Education,* 41, no. 8, (11 de noviembre 2014), 1447-1462, https://doi.org/10.1080/03075079.2014.977859.

[2] Roxana Pey and Sara Chauriye, *Innovación Curricular en las Universidades del Consejo de Rectores 2000 – 2010*. (Chile: Consejo de Rectores, noviembre 2011), 91, https://sct-chile.consejoderectores.cl/documentos_WEB/Innovacion_Curricular/2.Informe_INNOVACION_CURRICULAR.pdf.

[3] Ángel Díaz-Barriga, "Competencias en educación. Corrientes de pensamiento e implicaciones para el currículo y el trabajo en el aula", *Revista Iberoamericana de Educación Superior (ries)*, 2, no. 5, (México, unam-iisue/Universia, 2011), 3-24, http://ries.universia.net/index.php/ries/article/view/126.

of thought better defined their stances, with North American pragmatic pedagogy in the basic education level as an example of this movement.

Higher education was belatedly impacted by this discussion. It was not until the eighties that a favorable tendency to orient the curriculum to the needs of the labor market and social context started to brew in European circles. The Bologna Declaration made a referent to go forward in this direction. Studies that provided an empirical base were given an impulse under the suspicion that university and academia was not fully connected to the labor market demands. The DESECO, REFLEX and PROREFLEX projects later confirmed this hypothesis.

The Tuning project came to offer a methodology to innovate the curriculum and connect higher education to the needs given by social context. This methodology was quickly adopted by Latin American countries, Chile among them.[4] The following components were particularly popular: (1) Generic competences; (2) Subject specific competences; and (3) Academics credits.[5] In respect of generic competences, there has been no consensus reached about what it fully encapsulates, sowing doubt in some authors over the convenience of focusing solely on skills.[6]

The controversy around generic competences has stressed higher education institutions, pressured by the government and the labor market to respond to employability requirements. In fact, current career paths show that, despite living in a society dominated by knowledge, higher education does not constitute a guarantee of insertion and employability. This situation has generated uncertainty regarding the quality of graduates, questioning the role of higher education in the formation of transferable generic skills.[7] These are considered essential in the current labor market to increase individual employability.[8,9] In response to this, universities have sought

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[4] Pey and Chauriye: "*Innovación Curricular",* 20.

[5] Julia González, and Robert Wagenaar, eds., *Tuning educational structures in Europe: Final Report. Phase One* (Bilbao: University of Deusto and University of Groningen, 2003), 22.

[6] Richard Harris and Barbara Ormond, Historical knowledge in a knowledge economy – what types of knowledge matter? *Educational Review*, 71, no. 5, (25 de abril de 2018), 564-580. https://doi.org/10.1080/00131911.2018.1462764.

[7] Scott A. Hurrel, "Rethinking the soft skills deficit blame game: Employers, skills withdrawal and the reporting of soft skills gaps", *Human Relations,* 69, no. 3, (2016), 605–628.

[8] Marilyn Clarke, "Rethinking Graduate Employability: The Role of Capital, Individual Attributes and Context", *Studies in Higher Education*, 43, no. 11 (23 de febrero de 2017), 1923–1937, https://doi.org/10.1080/03075079.2017.1294152.

[9] Johanna Elizabeth Crossman and Marilyn Clarke, "International experience and graduate employability: stakeholder perceptions on the connection", *Higher Education,* 59, (2010), 599-613. https://doi.org/10.1007/s10734-009-9268-z.

strategies to increase their role in the development of generic skills, a process from which some considerations arise. However, the problem does not seem easy to solve, in light of the evidence and results.[10,11]

First, by virtue of the link between generic skills and employability, the first challenge is to adequately define the concept of employability of graduates. Despite the elapsed time, there is no clear consensus on this.[12] In Latin-America, generic skills were defined as those that "(…) identify the shared elements, common to any degree, such as the ability to learn, to make decisions, to design projects, interpersonal skills" by the report of the Tuning Latin America Project. 27 generic skills common to any profession were identified.[13]

A second aspect is to establish how important generic skills really are. Balcar[14], Heckman, Stixrud and Urzua[15] and Abaida, Lakrari and Abdouni[16] have provided strong evidence that in the determination of salaries, generic skills are as or more important than specific skills.

Thirdly, it is important to define which ones are the generic skills valued by employers. The underlying hypothesis is that those who have a professional degree and have also managed to develop the skills that better respond to the needs of employers would have a more expeditious transition towards job placement, which is considered an indicator of the relevance and quality of the training.[17] At the same time, it is interesting to note that the valuation of skills by employers may not coincide with that of the students.

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[10] Fatima Suleman and Ana María Costa, "The employability skills of graduates and employers' options in Portugal: An explorative study of anticipative and remedial strategies," *Education + Training*, 60, no. 9 (2018), 1097-1111, https://doi.org/10.1108/ET-10-2017-0158.

[11] Fraser J. Scott, Pauline Connell, Linda A. Thomson and Debra Willison, "Empowering students by enhancing their employability skills", *Journal of Further and Higher Education,* 43, no. 5 (2017), 692-707, https://doi.org/10.1080/0309877X.2017.1394989.

[12] Clarke, *"Rethinking"* (2017), 1923-1937.

[13] Pablo Beneitone, César Esquetini, Julia González, Maida Marty Maletá, Gabriela Siufi and Robert Wagennar, *Informe Final del Proyecto Tuning América Latina: Reflexiones y perspectivas de la Educación Superior en América Latina*. (Bilbao, España: Universidad de Deusto & Universidad de Groningen, 2007), 430, http://tuning.unideusto.org/tuningal.

[14] Jiří Balcar, "Is it Better to Invest in Hard or Soft Skills?" *The Economic and Labour Relations Review* 27, no. 4 (2016), 453–470, https://doi.org/10.1177/1035304616674613.

[15] James J. Heckman, Jora Stixrud and Sergio Urzúa, "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior", *Journal of Labor Economics*, 24, no. 3 (2006), 411-482, http://www.jstor.org/stable/10.1086/504455.

[16] Abdellah Abaida, Youssef Lakrari and Abdeljabbar Abdouni, "An examination of the relationship between competences and wages of higher education graduates: Evidence from Morocco", *Tuning Journal for Higher Education,* 5, no. 1, (30 de noviembre de 2017), 75-100 http://dx.doi.org/10.18543/tjhe-5(1)-2017pp75-100.

[17] Lee Harvey, "Defining and Measuring Employability", *Quality in Higher Education,* 7, no. 2 (2010), 97-109, http://dx.doi.org/10.1080/13538320120059990.

Different studies have concluded that there would be a mismatch between the skills obtained in higher education and those demanded by the productive sector.[18,19,20] In this way, the need to identify a set of generic skills in the graduation profiles of any professional degree taught by a university institution arises. This assessment is dynamic. According to the World Economic Forum the most sought-after generic skills in 2015 may not be the same in 2023.[21] For example, this body estimates that the skills of analytical thinking and innovation, active learning and learning strategies, creativity, originality, and initiative, technology design, and programming, critical thinking and analysis, among others, will be the most valued by 2023.

Other authors have identified that fundamental skills include communication, teamwork, problem solving, and critical and innovative thinking, creativity, self-confidence, ethical understanding, lifelong learning ability, ability to cope with uncertainty, and willingness to accept responsibilities.[22,23,24,25,26,27]

Another aspect that adds to the above is the increasing automation of industry and services. This occurrence will imply the loss of importance of

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[18] Bárbara Fenesi and Faria Sana, "What is your degree worth? The relationship between post–secondary programs and employment outcomes", *Canadian Journal of Higher Education,* 45, no. 4 (2015), 383-399, http://journals.sfu.ca/cjhe/index.php/cjhe/article/view/183604/pdf_48.

[19] Anthony P. Carnevale, Cheah Ban and Jeff Strohl, *Hard Times: College Majors, Unemployment and Earnings: Not All College Degrees Are Created Equal*. (Georgetown: Georgetown University, 2013), 3-17, http://hdl.handle.net/10822/559308.

[20] John Robst, "Education and job match: The relatedness of college major and work", *Economics of Education Review,* 26, no. 4 (2007), 397-407, https://doi.org/10.1016/j.econedurev.2006.08.003.

[21] World Economic Forum, *The Future of Jobs Report* (World Economic Forum, 2018), 9-13, https://www.weforum.org/reports/the-future-of-jobs-report-2018.

[22] Clarke, *"Rethinking",* 1923-1937.

[23] Tim Moore, and Janne Morton, "The Myth of Job Readiness? Written Communication, Employability, and the 'Skills Gap' in Higher Education," *Studies in Higher Education,* 42, no. 3 (2017), 1–19, https://doi.org/10.1080/03075079.2015.1067602.

[24] Senia Kalfa and Lucy Taksa, "Cultural Capital in Business Higher Education: Reconsidering the Graduate Attributes Movement and the Focus on Employability", *Studies in Higher Education,* 40, no. 4, (2015), 580–595, https://doi.org/10.1080/03075079.2013.84221.

[25] Jane Andrews and Helen Higson, "Graduate Employability,'Soft Skills' Versus 'Hard' Business Knowledge: A European Study", *Higher Education in Europe,* 33, no. 4 (2008), 411–422, https://doi.org/10.1080/03797720802522627.

[26] Dominique Rychen and Laura H. Salganik (ed.), *Key Competences for a Successful Life and Well-Functioning Society*, (Göttingen, Germany: Hogrefe & Huber Publishers, 2003), 181-186.

[27] Lee Harvey, William Locke, and Alistair Morey, *Enhancing employability, recognizing diversity Making links between higher education and the world of work* (London: Universities UK, 2002), 10-12.

various skills, as certain tasks are automated.[28] In this context, the OECD has considered identifying the relevant skills in 2030, amid special challenges in environmental, social, and economic issues.[29] They identify three areas of competence that will be key to face the challenges identified: creating new value (sustainable development), reconciling tensions and dilemmas, and taking responsibility.

In Europe and Latin America, universities have approached training in generic skills based on the approach installed by the Bologna Process and concretized through the Tuning-Europe project, initiated in 2001 with 175 European universities.[30] The countries of Latin America, from 2003, begin their own itinerary with the Tuning-Latin America project.[31]

In Chile, the Tuning Project had an important effect on the higher education system, almost completely adopting its postulates. The adaptation of the educational projects of the institutions to Tuning materialized through a process called curricular innovation. In the decade between 2000-2010, numerous curricular innovation initiatives were developed under this financing line, the common aspects being: (1) the definition of graduation profiles as an articulating element of the degrees and degrees, (2) student centrality and learning time (3) integrative curriculum structure, and (4) training process organized in generic and specific skills.[32] In fact, Chilean traditional universities started this process of curricular innovation through funds coming from the higher education's quality improvement projects (MECESUP), financed by the Education Ministry. All the universities considered in the present study have implemented their curricular innovation process with state funding; funding that considered i) initial implementation of this new curriculum focused on learning outcomes and tuned to the labor market's and social context's needs, and ii) the definition and initial

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[28] Jacques Bughin, Eric Hazan, Sudan Lund, Peter Dahlström, Anna Wiesinger, & Amresh Subramaniam, *Skill Shift Automation and the Future of the Workforce,* (McKinsey Global Institute, 2018), 1-49, https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Future%20of%20Organizations/Skill%20shift%20Automation%20and%20the%20future%20of%20the%20workforce/MGI-Skill-Shift-Automation-and-future-of-the-workforce-May-2018.ashx.

[29] OECD, *The future of education and skills. Education 2030,* (OCDE, 2018), 23. https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf.

[30] Alberto Amaral, Guy Neave, Christine Musselin and Peter Maassen, *European Integration and de Governance of Higher Education and Research* (Springer, 2009), 3-58.

[31] Julia González, Robert Wagenaar and Pablo Beneitone, "Tuning - América Latina: un proyecto de las universidades" *Revista Iberoamericana de Educación,* 35 (2004), 151-164, https://rieoei.org/historico/documentos/rie35a08.pdf.

[32] Pey and Chauriye, *Innovación Curricular*, 36.

implementation of a system for academic credit transfer (SCT-Chile, compatible with the European ECTS) that provides students national and international mobility and advancement towards the articulation of different level of higher education.

The National Accreditation Commission in Chile also states that any curriculum should explicitly contemplate general learning objectives, such as communication, critical thinking, problem solving, social interaction, self-learning and personal initiative, training and ethical consistency, globalized thinking, citizenship training, and aesthetic sensibility.[33]

Finally, it should be noted that in 2018, two laws were passed in Chile: one for Higher Education[34] and another for public universities.[35] These laws, among other matters, define a set of generic skills that institutions in general, and public institutions in particular, should contemplate in their training processes. There, it is defined that it is the function of universities to seek the integral and ethical training of people, oriented to the development of autonomous and critical thinking. This encourages them to participate and contribute actively in the different areas of life in society, according to their talents, interests, and abilities. In the case of the law for public universities, it is specified that as a constitutive and inescapable element of their mission, the public universities must train people with a critical and reflective spirit that promotes rational dialogue and tolerance, and that contributes to forge a citizenship inspired by ethical, democratic, civic and social solidarity values, respectful of the native population and the environment. In regions with more abundant native population, the local public universities must include in their mission the recognition, promotion, and incorporation of their worldview.

The current public universities in Chile were created from the regional headquarters of two large government-owned universities: University of Chile and State Technical University. During the Military Government (1973-1989), a reform of the higher education system was carried out, creating 14 public universities in the period. During the last government of Mrs. Bachelet (2014-2017) two new regional universities were created.

In the Chilean higher education system, there has been a growing differentiation and competition between public and private universities. The

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[33] Comisión Nacional de Acreditación, *Criterios para la acreditación de carreras*. (Santiago, Chile, Comisión Nacional de Acreditación, 2016), 1- 16. https://www.cnachile.cl/Criterios%20y%20Procedimientos/DJ%20009-4%20Criterios.pdf.

[34] Ley N° 20.901, *Diario Oficial de la República de Chile*, (Chile: Santiago; May 11, 2018).

[35] Ley N° 20.904, *Diario Oficial de la República de Chile*, (Chile: Santiago, May, 25, 2018).

latter do not receive subsidies from the government, unlike the former. However, private universities have led the growth of seats, and the expansion of the coverage of university education is largely due to their actions. On several occasions, some private universities have been accused of acting with profit criteria, which is prohibited by Chilean law. Others have been closed by the government for not ensuring quality service.[36]

III. Data

The population studied are public universities. It should be noted that there are 18 universities of this type in Chile.

The studied population is traditional universities. It is important to note that in Chile, there is only 18 higher education institutions that belong to this group. Out the 18, two of them have been founded recently and do not count with graduated alumni as of the moment in which the present study was conducted. For this reason, they were not considered.

The information used in the study came from the following sources:

a) Secondary sources: oficial documents from each institution, such as the education model, complementary documents that describe the generic competences, and information available in institutional websites.
b) Structured interviews: A questionnaire was applied to teaching directors of each one of the 18 universities. The questionnaire comprehended 16 closed-ended questions and three open-ended ones. The main topics considered were: i) identification of the main referents used to define the generic competences of the institution, ii) Curricular Implementation modality of generic competences, iii) Distinction between generic competences and institutional seal, iv) changes made to the generic competences since their initial definition, v) Identification of communication and improvement mechanisms regarding generic competences, vi) Perception of the understanding level of generic competences among members of the universities's teaching community, and vii) Monitoring and evaluation mechanisms for generic competences. The validity of this instrument was evaluated by an external party. The results obtained were analyzed in contrast with a documental analysis to give more robust results.

[36] María O. Monckeberg, *Con fines de lucro. La escandalosa historia de las universidades privadas de Chile,* (Santiago, Chile, Debate, 2013).

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Data analysis:

a) Documental review: In a first stage, this analysis allowed to identify the generic competences that each institution declared in their respective education model, so later they could be classified following a code of identification that allowed to unify criteria and names. This method permitted the competences found to be quantified and grouped according to a typology made by the authors of the present study. The typology was based on the most used concepts by the institutions, producing a standardized denomination for each generic competence.
   In the second stage, a data base with the following variables was constructed.

   - University's name
   - Denomination used by the institution to refer to a specific competence. This was considered to be necessary, since not all institutions used the same concepts. Seal, attribute, skill, and competence are used indiscriminately.
   - List of attributes, skills, competences, seal, or any other identified by the institution that alluded to generic competences.
   - Standardized denomination for each generic competence.
   - Standardized codification for each generic competence by the investigators.
   - Definition of each generic competence given by the respective institution.
   - Declaration of institutional seal.
   - Sources of information transparency.
   - Date of the source

   The descriptive analysis of the compiled data base considered the frequency of each generic competence declared as part of the institutional seal and was later compared to the total amount of generic competences found across all institutions.
b) Structured interview: the resulting data was processed in Excel to analyze the frequency of the observed variables, this in lieu of the small sample size. This data was used as base to tackle the questions in the semi-structured interview.
c) Semi-structured interview: the data obtained from these interviews was analyzed with the content analysis technique with the goal of

identifying the categories that surged spontaneously from the interviewed directors' discourse. Finally, all information sources were triangulated to describe the results.

Table 1 shows participation of institutions according to the instrument applied and the data supplies by each one of them.

Table 1

Type of information source and the data each provided

Information source type	Documental review	Structured interviews	Semi-structured interviews
Number of universities	18 universities	18 universities	13 universities
Data provided by each source of information	i) number of generic competences by institution, ii) Names of each generic competence given by each institution iii) Generic competences' definition by each institution	i) Main referents used to define generic competences in the institution's identification. ii) Curricular implementation of generic competences' modality. iii) Distinction between generic competences and institutional seal iv) Modification made to the generic competences since they were first defined v) Identification of the diffusion mechanism and teaching further development in the topic of generic competences vi) Level of knowledge available about generic competences's perception in the university's community. vii) Mechanisms to follow up and asses generic competences	Further insight on the following aspects: i) curriculum, ii) organization, iii) budget, iv) assessment

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IV. Results

IV.1. Generic skills' selection process

All institutions have used participatory mechanisms, which consist of consultations with the various institutional bodies, clusters, workshops with a wide call, academic representatives' commissions, and, in some cases, external experts. In addition, all institutions have considered consultation with employers and graduates. Only in some institutions considered student participation as well.

The use of participatory mechanisms implies an important investment of time. In this sense, there is a coincidence in the institutions that reaching agreements demanded, at least, one year of work. All the institutions participating in the study have selected generic skills through commissions made up of scholars and, in some cases, also external experts. The participation of students in the selection of generic skills was mentioned only by the minority of the institutions.

The following criteria were indicated by the institutions as those used to define generic skills:

- Labor market requirements (Information from graduates and employers).
- The educational model of the institution.
- Institutional mission.
- Institutional values.
- Agreements between universities.
- Latin American Tuning Project.
- Student admission profile.
- Demands of students raised in protests.
- Institutional accreditation requirements.
- Institutional seal.

Among these criteria, the ones most frequently mentioned correspond to the institutional mission, institutional seal, educational model, and demands of the working environment.

The result of the commissions' work, as expressed by all the universities, was collected in reports that recommend a set of generic skills, which were approved by academic governing bodies of the university. Finally, generic skills are published in the curriculum documents of the respective programs, specifically in the graduate profile and additionally in educational model documents. Subsequently they are disseminated in advertising intended to attract applicants.

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The process involved a significant investment of time. In the present case, it took around a year. This time frame includes the process of consulting employers and graduates.

IV.1.1. Generic skills

Universities use different denominations to refer to generic skills. They are called institutional seal, formative seal, identity seal, intellectual abilities, personal qualities, instrumental competences, among others.

The studied universities identify 117 generic competences. Table No. 1 presents some general data.

Table 2

Number of generic competences of the 18 public universities.

Total	117
Average per institution	6.5
Mode	6
Minimum per institution	3
Maximum per institution	13

Source: Educational models of the universities of the State of Chile.

The quantity of generic competences declared by the 18 traditional universities amount to 117. The big majority of them refer to the same skill or attribute with different names. Because of this, a standardized denomination system was used to better classify them.

Table 1 describes measures of key trends presented by the generic competences compilated. As one can observe, institutions have a median of 6,5 generic competences. The data is further described in table 2. The number of generic competences since they were selected and defined by the respective institution has experimented changes during the process of reformulation in most universities. In this process, a tendency to reduce the initial number and better define them has been highlighted. These adjustments have happened considering new teaching plans that consider the actual capacity the institution has to pass down these competences to their students. In other words, a criterion of efficacy has predominated, hoping to generate a more ambitious and successful profile for graduates.

Finally, the modification in terms of quantity and definition of generic competences have happened in the context of upgrades to the formative models.

Table 3

Distribution of generic skills in public universities

Skills identified by the institutions	Frequency	%
Effective communication	14	77,8%
Ethics	11	61,1%
Teamwork	11	61,1%
Autonomous learning	10	55,6%
Social responsibility	10	55,6%
English	8	44,4%
Information and communication technologies	7	38,9%
Innovation and entrepreneurship	6	33,3%
Leadership	6	33,3%
Critical Thinking	4	22,2%
Commitment to quality	3	16,7%
Sustainability	3	16,7%

Abstraction, analysis and synthesis, ability to apply knowledge into practice, consideration of the global context, mathematical skills, social skills, information management, and troubleshooting were mentioned twice.

Adaptability, research capacity, active citizenship, regional commitment, disciplinary knowledge, disciplinary innovation, multiculturalism, results orientation, technology, and tolerance were mentioned once.

Source: Educational models of the universities of the State of Chile.

It is found that there is a coincidence in a subset of generic skills that are the most frequent. Effective communication, teamwork, ethics, social responsibility, and autonomous learning. This coincidence has happened without the institutions having reached a formal agreement. This demonstrates the cross-cutting nature of generic skills and convergence in graduation profiles.

Regarding the definition of these competences, in most cases a document stating the official definition, their progression levels and respective goals,

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exists. In this sense, while many common elements exist across institutions and competences, each university has gone through this process in an independent manner. This happens because there is no consensus or sole way of understanding most of these concepts, like effective communication, teamwork, or leadership, for example. In consequence, the direction given to each competence answers to the university's point of view and perspective. In fact, the Latin America Tuning Project identifies a group of 27 generic competences, but does not provide operationalization, leaving this part to the institutions.

Concerning the evolution of generic skills since they were selected and defined by the institutions, the majority have experienced reformulation processes in which a tendency to decrease their initial quantity stands out. The evolution of the number of generic skills since they were selected and defined by the institutions, 7 of 13 have undergone reformulation processes with respect to those declared in the first version of the educational model. In these reformulations, a tendency to decrease the initial amount of these competences is highlighted, as well as to specify their definition. The argument that supports these adjustments is the real capacity of a curriculum to effectively train in a set of generic skills that students must demonstrate. That is, the effectiveness criterion of the training process has been privileged, after experimenting with a more ambitious graduation profile, in the sense of the number of generic competences and how cross curricular they are in the undergraduate programs of each institution.

The modifications in terms of number and definition of generic skills have been made in the context of updates of the educational models.

IV.1.2. Institutional seal

An aspect that is important to consider is the so-called institutional seal, as it is often confused with generic skills. The institutional seal usually represents a subset of the generic skills, which are understood by the institutions as the identity of the training and consequently, directly linked to the university's mission.

50% of the total generic skills declared by the studied institutions are indicated as an institutional seal, as shown in the following table.

The difference between a generic competence and a "seal" competence is in the emphasis given to the latter ones both in the teaching process and institutional extracurriculars oriented to reinforce them. In fact, it is each university's goal to have alumni recognized by this seal, when compared to graduates from other institutions.

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Institutional seal competences have been incorporated only recently in higher education curricula, therefore there is not enough evidence on this topic. Many authors agree about the complexity that implies evaluating the achievement of these competences inside a formative process, particularly in terms of acquiring evidence of this achievement. One way to do so is interviewing the employers of their graduates.[37,38] This kind of practices has been installed as a quality insurance mechanism in the face of accreditation processes at the national level.[39]

Table 4

Generic competences declared an institutional seal by the universities of the State of Chile

Generic competences declared formative seal	Frequency
Yes	58
No	59
Total	117

Source: Own elaboration based on institutional educational models.

The "seal" generic skills with greater presence in public institutions are social responsibility, ethics, effective communication, teamwork, communication technologies, and English. Of the 29 generic skills identified in this study, 22 of them are those that make up the institutional seal (75.9%).

What has been observed in the studied universities, is that the institutional seal has become a new component in the training processes. It has given rise to specific subjects within the curriculum, its incorporation into disciplinary subjects, and even the design of extracurricular initiatives to support training in the generic skills that make up the institutional seal. Accordingly, the evidence contributed by the present study shows that the 13 universities have all designed curricular activities specifically to promote the development of

[37] Claude Lessard, "La réforme du curriculum québécois et son difficile atterrissage", *Revue internationale d'éducation de Sèvres*, 73, (2016), 95-106, http://journals.openedition.org/ries/5623.

[38] Alejandro Sepúlveda Obreque, Margarita Opazo Salvatierra, Danilo Díaz-Levicoy. "Competencias sello en la universidad: promoción y evaluación en Pedagogía Básica". *Cuad. Investig. Educ.*, 9, no. 1, (Montevideo, 2018), 35-46.

[39] Comisión Nacional de Acreditación, *Criterios para la acreditación de carreras*, (Santiago, Chile, 2016), https://www.cnachile.cl/Criterios%20y%20Procedimientos/DJ%20009-4%20Criterios.pdf.

the seal competences, ensuring in this way that they are present in all formative programs and therefore guaranteeing all their students have received the training. A group of institutions have chosen a mixed modality, meaning they combine extracurricular activities with a transversal training throughout the whole curriculum.

Another interesting aspect of the institution's seal is the fact that this acquires different nuances depending on the geographical location of the institution. It is the case of regional (as opposed to those in the capital) universities where a link with the region's characteristics can be found. For example, for those universities in regions where there is many first nation people, multiculturalism and diversity become more present and relevant compared to other competences. For another group of universities, the competences declared as part of their seal are more pragmatic. In this way, it surprises to find among the seal competences some transversal ones that make part of the seal in most universities, making their profile less unique.

Finally, in the minority of universities, it was observed that all generic competences were equivalent to the institutional seal, meaning that outside of their seal, they did not consider any other competences of importance.

These modalities of curricular implementation of the formative seal give account of the relevance that universities attribute to the graduation profile component, in which all institutions link generic competences. Meaning, there is not a single university that does not consider generic competences in their seal.

IV.1.3. Modality of curricular implementation of generic skills

In general, there is no explicit adherence to a specific theoretical approach in the curricular implementation of generic skills. Institutions have adopted the student-centered approach to teaching-learning as a predominant paradigm, which translates into the use of active methodologies and the definition of learning achievements or outcomes. For example, it was observed that institutions tend to use methodologies such as projects, learning based in problems, simulations, teamwork, etc. On the other hand, most of the evaluation instances were inside curricular activities that belong to the general formative programs. Some universities have opted for evaluations integrated on the courses when these are disciplinary. Others have chosen to use landmarks through assigning integrated activities. These are usually placed by the end of formative cycle, becoming a sort of intermediate evaluation of graduation profile.

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Only the minority of universities apply diagnostics to measure how the students are regarding these competences when they first arrive.

As for the curricular design, only some institutions claim to have a competences curriculum in the classical sense (modular and progressive), the rest declare a curriculum based on skills (generic and specific) and expressed in learning achievements or learning outcomes.

All universities declare that generic skills are included in the graduation profile of undergraduate curricula. In this area, the institutions have adopted the guidelines agreed by the Council of Rectors of Chilean Universities[40] regarding curricular innovation. These orientations have a pragmatic rather than theoretical character, in the sense that higher education institutions respond functionally to the requirements of the labor market. Meaning, universities make periodic interviews to employers to know which are the labor market current needs, so they can construct a profile that allows easy insertion once graduated. These interviews are usually done biannually and are part of the mechanisms universities have to establish a link with the labor market.

On the other hand, the process of curricular implementation has had greater complexity in those universities whose academic offer is wider and more diverse than those with a limited academic offer and less heterogeneous in the discipline. Amon the 18 traditional universities, 13 of them count with wide offer of programs in almost all disciplines. The other five count with a more limited offer.

Regarding the modalities used by the institutions to implement the generic competences in the curriculum, three variants are distinguished. The information provided by each institution allowed the team of researchers to classify the modalities of implementation according to what the literature presents. These are (1) in specific subjects (focused), (2) in transversal subjects, or (3) in a combination of both (mixed). These modalities have been described by Yañiz and Villardón,[41] Robley, Whittle and Murdoch-Eaton[42] and Bennett, Dunne and Carre.[43]

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[40] Cluster of public and private-owned Chilean universities that were founded before 1980.

[41] Concepción Yániz, Lourdes Villardón, "Modalidades de evaluación de competencias genéricas en la formación universitaria", *Didac*, 60, (2 de julio de 2012), 17-18.

[42] Will Robley, Sue Whittle & Deborah Murdoch-Eaton, "Mapping generic skills curricula: a recommended methodology" *Journal of Further and Higher Education*, 29, no. 3 (2005), 221-231, https://doi.org/10.1080/03098770500166801.

[43] Neville Bennett, Elisabeth Dunne and Clive Carre, "Skill Development in Higher Education and Employment" In *Differing Visions of a Learning Society Vol 1: Research Findings*, edited by Coffield Frank. (Bristol, UK: Bristol University Press, 2000), 105- 138.

Most public institutions have opted for the mixed modality. This option is to ensure that the generic competences are developed during the entirety of the formative process.

Focused: The generic skills are explained in specific subjects of the curriculum, dedicated exclusively to their development. These are the so-called Comprehensive Training Programs, Fundamental Training or General Training, which congregate a set of subjects of a transversal nature to all the careers of the institution.

These transversal subjects reach the highest level of achievement for generic skills. They usually respond to training in the institutional seal or to the generic skills of the graduation profile.

One of the difficulties of this implementation is related to the academic load that is added to the curricula in relation to the disciplinary subjects. It implies that the career must grant hours and credits for these curricular activities, which have a lower assessment than the subjects of the discipline in the opinion of the interviewees. This situation creates a tension that necessarily implies installing a process of curricular "negotiation".

The main questioning from literature to this type of implementation is that generic skills are not transferred to other learning spaces, since they are limited only to certain subjects, without offering the student the possibility of developing it in a systematic process and in intensity levels that allow its appropriation.

The positive thing about this modality is that it facilitates the management and evaluation of generic skills due to the fact that they are limited to a curricular activity dedicated exclusively to their development. This modality is adopted by 2 of 13 institutions.

Transversal: Generic skills are declared in all subject programs of a program's curriculum, or in some of them. In turn, the association of generic skills with the program's curriculum can be total or partial. This means all or those that are chosen according to selection criteria are associated to the selected generic skills. These selection criteria also incorporate the levels of progression that generic skills must reach. Those generic skills that are part of the institutional seal are mandatory.

The greater complexity of this modality is related to the preparation of teachers to understand the scope of the incorporation of these skills in the subject programs. This is also true for the pedagogical training that allows the university teaching staff to use according teaching-learning methodologies.

On the other hand, generic skills are required to have a direct relationship with the subject, either through its contents and / or through methodological strategies of the teaching-learning process to promote them in its students.

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Another complexity of this modality is related to the evaluation of the achievement of generic skills when they are inserted in disciplinary subjects, which requires having a trained and aligned teaching team. This modality is adopted by 2 of 13 institutions.

Mixed: The generic competences are explained in specific subjects of the curriculum dedicated exclusively to their development and also in the disciplinary subjects. In the latter, the taxation may be total or partial, depending on the criteria that each institution has adopted. This modality can acquire three expressions.

- Mixed A: The generic skills are declared in all the subject programs of a study plan and also includes a set of specific subjects dedicated exclusively to the generic skills. It is a rigid curricular design for all the institution's programs.
- Mixed B: The generic skills are declared, according to certain criteria, only in some subject programs of a curriculum and also contemplates a set of specific subjects dedicated exclusively to the generic skills. It is a flexible curriculum design, which allows differentiation.
- Mixed C: Refers to any of the previous modalities that contemplates extracurricular activities that allow to demonstrate the acquisition of certain generic skills through a system protocolized by each institution. Extracurricular activities include volunteering, participation in congresses, student groups, employability strengthening workshops, university adaptation workshops, among others.

Most institutions have opted for Mixed A or Mixed B modalities (9 of 13 institutions).

The depth of development of generic skills in the training process has been established at levels of progression. That is, for each generic skill, a three-level scale is defined through learning achievements, learning outcomes, or key performances (the name depends on each institution).

Regarding the quantity of generic skills present in a subject within a curriculum, the existence of a defined number or a specific range was not verified.

V. Discussion

The modality of participatory commissions for the selection of generic skills used by the studied institutions coincides with that indicated by Palmer,

Montaño and Palou[44], in the sense that to choose the generic skills, the opinion of four social actors is required: a) the academic community, b) employers, c) graduates and d) professional associations. Tran Le Huu Nghia[45], refers to actors as external stakeholders for the training provided in higher education, with the participation of employers, non-governmental organizations, public services, and local authorities becoming increasingly important. This is also noted by Chowdhury and Miah,[46] and Jackson and Chapman.[47]

Regarding the number of generic skills selected by each institution, a variation between 3 and 13 generic skills was observed with an average of 6.5 per university. In this regard, Villa and Poblete[48], starting from the experience of the University of Deusto recommend proposing between 8 to 10 generic skills for a curriculum of 30 subjects. It should be considered that in Europe, the duration of the programs leading to the bachelor's degree is on average less than the duration in Latin America.

Each university decides how many generic skills to assume for its graduation profiles. This decision does not have official standards, and as such, becomes self-determined. This situation adds considerable difficulties to it. Another difficulty is the negotiation that must be established with the programs to install the generic skills in the curricula. In this regard, Villa and Poblete[49], recommend discussing the map of generic skills with teachers, in order to establish a direct link with the

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[44] Alfonso Palmer, Juan J. Montaño and María Palou, "Las competencias genéricas en la educación superior. Estudio comparativo entre la opinión de empleadores y académicos," *Psicothema,* 21, no. 3, (2009), 433-438.

[45] Tran Le Huu Nghia, "External stakeholders' roles and factors influencing their participation in developing generic skills for students in Vietnamese universities", *Journal of Education and Work* 31, no. 1, (2017), 72-86, https://doi.org/10.1080/13639080.2017.1386774.

[46] Tamgid Ahmed Chowdhury, and Mohammad Khasro Miah, "Employability Skills for Entry-level Human Resources Management Positions: Perceptions of Students and Employers", *Australian Journal of Career Development* 25, no. 2, (2016), 55–68, https://doi.org/10.1177/1038416216658774.

[47] Denise Jackson and Elaine Chapman, "Non-technical Skill Gaps in Australian Business Graduates", *Education + Training,* 54, no. 2–3, (2012), 95–113, https://doi.org/10.1108/00400911211210224.

[48] Aurelio Villa and Manuel Poblete, "Evaluación de Competencias Genéricas: Principios, Oportunidades y Limitaciones", *Bordón, Revista de Pedagogía*, 63, no. 1, (2011), 158, https://recyt.fecyt.es/index.php/BORDON/article/view/28910.

[49] Aurelio Villa and Manuel Poblete, "Evaluación de Competencias Genéricas: Principios, Oportunidades y Limitaciones", *Bordón, Revista de Pedagogía,* 63, no. 1, (2011), 158, https://recyt.fecyt.es/index.php/BORDON/article/view/28910.

subjects and minimize the less relevant status for generic skills in the training process.

From another perspective, Villarroel and Bruna[50] warn about the complexity in the selection of generic skills and their integration on the different programs. This because there would be no clear consensus regarding more transversal generic skills and, therefore, their relationship may be more evident in some programs and less in others. In fact, the studied institutions have decreased the amount of generic skills that they initially selected, appealing to the real capacity for training of their students.

The demands of the labor market have been a factor considered in the graduation profiles by all the studied institutions. This finding coincides with that indicated in various studies.[51,52,53,54] The multifunctionality developed by generic skills in professional performance makes employers demand this type of higher education training. This, according to Rodríguez[55], would increase the employability of graduates and improve productivity and competitiveness.

Regarding the generic skills selected by the studied universities and which have a greater convergence (effective communication, teamwork, ethics, autonomous learning and social responsibility), there is a coincidence with other studies. Delloite[56] identified oral communication, commitment to work, and teamwork as the most important for improving employability. A similar result in Europe identified oral communication, teamwork, ability to

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[50] Verónica Villarroel, & Daniela Bruna, "Reflexiones en torno a las competencias genéricas en educación superior: Un desafío pendiente", *Psicoperspectivas,* 13, no. 1, (2014), 22 – 34, https://dx.doi.org/10.5027/psicoperspectivas-Vol13-Issue1-fulltext-335.

[51] Balcar, "Better to Invest in Hard or Soft Skills?" 453–470.

[52] María Elena Cano, "La evaluación por competencias en la educación superior", *Revista de Currículum y Formación del Profesorado,* 12, no. 3, (2008), 1-16, https://www.ugr.es/~recfpro/rev123COL1.pdf.

[53] Marta Haro. "Actividades que ayudan a desarrollar las competencias genéricas del ámbito educativo, in *Competencias genéricas y transversales de los titulados,* Ed. ICE de la Universidad de Zaragoza (Zaragoza: Universidad de Zaragoza, 2008), 86-90, https://ice.unizar.es/sites/ice.unizar.es/files/users/leteo/publicaciones/col._documentos_08.pdf.

[54] Concepción Yaniz, "Planificar la enseñanza universitaria para el desarrollo de competencias", *Revista Educatio Siglo XXI*, no. 24, (España, 2006), 17-34, https://revistas.um.es/educatio/article/view/151.

[55] Hernando Rodríguez Zambrano, "El paradigma de las competencias hacia la educación superior", *Revista Facultad de Ciencias Económicas: Investigación y Reflexión*, vol. XV, no. 1, (Universidad Militar Nueva Granada Bogotá, Colombia, junio, 2007), 152.

[56] Deloitte, "Global Human Capital Trends", 2017, (Accessed November 1, 2019), https://www2.deloitte.com/global/en/pages/human-capital/articles/introduction-human-capital-trends.html.

think innovatively, and work under pressure as the most relevant generic skills.[57,58]

The sequence that the generic skills assume in the curricula of the public universities, only has a logic of progression in levels of achievement, which in the majority are quantified to a third level, using taxonomies of learning that go from knowing to applying.

Villa and Poblete[59] suggest including generic instrumental skills in subjects of the first years, and in the following years interpersonal and systemic skills (teamwork, leadership, among others). This proposal is based on the student body's academic maturity and its ability to correctly assess and develop interpersonal and / or systemic skills at the higher levels.

However, it is interesting what Kuhn and Weinberger[60], who studied the return of wages in the leadership skills in the United States, pointed out. The authors found that, in higher education students, there is a greater probability of assuming managerial positions when at the school stage they have directed sports or student teams and have also self-assessed as leaders. This confirms that the development of generic skills is a continuous process over time and that the more access people have to experiences that allow them to train these or other skills or abilities, the greater the probability of appropriating them.

As for the institutional seal, it is valid to ask what implications does it have for the training process? What value does it add to training? An explanatory hypothesis is that the massification of institutions of higher education has generated the need for differentiation between institutions. This has materialized in the so-called "formative stamps", which could add competitive advantages, given the "commoditization of higher education". Miller[61] has identified and described this trend.

The institutional seal in higher education institutions has generated an important effort at the curricular level, which has resulted in the creation of

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[57] Andrews and Higson, "Graduate Employability", 411–422.

[58] Enric Corominas, "Competencias genéricas en la formación universitaria", *Revista de Educación,* 325, (2001), 299-321, http://www.educacionyfp.gob.es/dam/jcr:1ba9ac11-1d4a-4679-845f-b0f77109a23f/re3252109962-pdf.pdf.

[59] Aurelio Villa Sánchez and Manuel Poblete Ruiz, "Evaluación de competencias genéricas: principios, oportunidades y limitaciones", *Bordón Revista de Pedagogía*, ISSN 0210-5934, ISSN-e 2340-6577, 63, no 1, (2011) 158.

[60] Peter Kuhn and Catherine Weinberger, "Leadership Skills and Wages", *Journal of Labor Economics,* 23, no. 3, (2005), 395-436, https://doi.org/10.1086/430282.

[61] Brian Miller, "Skills for sale: what is being commodified in higher education?" *Journal of Further and Higher Education,* 34, no. 2 (2010), 199-206, https://doi.org/10.1080/03098771003695460.

specific subjects for its development. This effort has been called focused implementation.[62] The incorporation of specific subjects, unusual in past decades, is today a component of curricular designs whose purpose is to materialize the university mission.

The main questioning of the modality of focused implementation is that generic skills are not transferred to other learning spaces, limited to the curricular activity that has been specially designed for its development. This criticism is based on the fact that the knowledge of a generic skill is not limited to a particular situation or discipline, but that its main attribute is its integrative character and the ability to be transferred to different situations and disciplines.[63] The advantage of the focused modality is that it facilitates management control and evaluation in the student body.

Special mention deserves the teaching performance, since those who teach in higher education, for the most part, do not have pedagogical training and therefore privilege disciplinary learning because that is the one they excel in. In this way, training in generic skills goes to the background, basically due to teachers' lack of knowledge about tools with which to develop them. Then it happens that the knowledge and methodologies to prosecute the teaching-learning process, are acquired in the teaching performance itself, spontaneously, by trial and error[64] replicating the same methods by which they learned.

Hence, the importance that higher education institutions have led to the pedagogical improvement of their academics, settling in as a need aimed at safeguarding the quality of teaching. Bain[65] in an effort to identify best practices of university teachers, highlights the importance of promoting intellectual and personal development with evidence, specifying that quality learning is one that manages to develop intellectual and personal students.

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[62] Concepción Yañiz and Lourdes Villardón, "Modalidades de evaluación de competencias genéricas en la formación universitaria". *Didac. Evaluación de los aprendizajes*, 60, (2012), 17.

[63] Benilde García, Javier Loredo, Edna Luna and Mario Rueda, "Modelo de evaluación de competencias docentes para la evaluación media y superior", *Revista Iberoamericana de Evaluación Educativa* 1, no. 3, (2008), 96-108, http://www.rinace.net/riee/numeros/vol1-num3_e/art8.pdf

[64] Fernando Moscoso and Adela Hernández, "La formación pedagógica del docente universitario: un reto del mundo contemporáneo," *Revista Cubana de Educación Superior,* 34, no. 3 (2015), 140-154, http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0257-43142015000300011&lng=es&tlng=es.

[65] Ken Bain, "Lo que hacen los mejores profesores universitarios", traducción Oscar Barberá, Universitat de Valencia, ISBN 978-84-370-6669-1 (2007), 103-111.

This author's affirmation confirms the contribution of generic skills in the integral education of higher education students.[66,67]

VI. Conclusions

There is strong evidence regarding the need to develop generic skills in higher education. Today, it becomes an unavoidable component of academic training given its integrative, transferable, and empowering nature of disciplinary learning, as well as the employability of graduates.

Despite the above, the institutions face a complex process when selecting generic skills. Since there are no standards, differences in the valuation that employers, academics, and graduates attribute to each generic skill are appreciated. The convergence between the actors involved necessarily requires adopting agreements.

Both in Chile and in other countries, the higher influence given to the opinion of employers when selecting generic skills is verified, understanding that the institutions expect to respond to the real and current needs of the labor market.

The Chilean public universities, although they converge in a subset of generic skills, have not reached this conclusion by intentional interinstitutional agreement.

Regarding the institutional seal, it is found that this corresponds to a fraction of the generic skills, which is closely linked to materialize the mission of each university in the training process, thus providing a component that is its own and distinctive.

Both in the selection of generic skills and in the institutional seal, an interesting debate is opened towards a possible space of convergence, since the new regulations for the public universities establish certain formative attributes in the student's graduation profile. This debate should also consider future trends in the labor market.

The evidence provided in this study demonstrates that the amount of generic skills that an institution assumes in its discharge profile has been a dynamic process, whose tendency has been to decrease its number. The explanation of this action is the actual capacity that the institution has to

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[66] María Elena Cano, "La evaluación por competencias en la educación superior, Profesorado", *Revista de Currículum y Formación del Profesorado*, 12, no. 3 (2008), 1-16.

[67] Concepción Yañiz, "Las competencias en el currículo universitario: implicaciones para diseñar el aprendizaje y para la formación del profesorado" *Revista de Docencia Universitaria*, Monográfico 1º (2008), 18, http://www.redu.um.es/Red_U/m1/.

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effectively form the generic skills in its students, considering both the disciplinary diversity and the heterogeneity of its student population.

On the other hand, the modality of curricular implementation of generic skills is a decision that faces advantages and difficulties. Among the most critical aspects, teachers' performance is identified in the development of generic skills and in the conviction of their importance, for which the training of the teaching staff becomes a necessity.

The progressive character in the learning and appropriation of the generic skills in the student body is another relevant conviction of the universities, since it is not possible that skills such as effective communication or teamwork are acquired in a single curricular activity or event of a student's curriculum. This learning is systematic and progressive in intensity levels.

Finally, although it may seem repetitive, it is important to recognize the dynamic nature of generic skills, particularly because of the context of speed in the scientific, technological and social changes of today's world. It implies and demands flexible curricular designs, capable of adapting and responding to the evolutionary dynamism of society.

The process is still happening and results in terms of satisfaction or return of graduates, or prestige for the institution are complex to isolate. The relationship between generic skills definition or implementation method with any of these factors is not yet well established. While generic skills face constant change in terms of their demand in the labor market, methods of implementation can have a more stable nature, yet it is not possible to say if there is a correct or superior method as there is no evidence that can safely link a method with acquisition of generic skills in higher education.

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The future challenges of scientific and technical higher education

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Abstract: The world is experiencing significant changes, including exponential growth of the global population, global warming and climate change, biodiversity loss, international migration, digitalization, smart agriculture/farming, synthetic biology, and most recently a global human health pandemic. These trends pose a set of relevant challenges for the training of new graduates as well as for the re-skilling of current workers through lifelong learning programs. Our paper seeks to answer two research questions: (1) are current study programs suitable to prepare students for their professional future and (2) are study programs adequate to deliver the needs of current and new generations of students? We analyzed the professional figures and the skills required by the job market, as well as the number of students enrolled in technical-scientific HE study programs in Europe. We discuss the needs of future students considering how the teaching tools and methods enabled by digitalization might contribute to increasing the effectiveness of training these students. Finally, we

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shed light on the different types of HE study programs that can meet the educational challenges of the future.

Keywords: HE system; education; challenges; Industry 4.0; engineering; agriculture.

I. Introduction

In the last decades, the world has experienced a number of significant trends. Most dramatically, we have experienced an exponential growth in global population, which has now reached almost 8 billion people.[1] The climate has changed, reaching a global mean warming of 1°C above the pre-industrialization period and leading to many storms and hurricanes, even outside their traditional areas.[2] Global biodiversity loss (both in water and soil) has been 100 to 1,000 times higher than naturally occurring levels.[3] The world's oil reserves are limited and are expected to be consumed in the near future;[4] the same is happening for non-renewable natural sources used for the production of some fertilizers in the agricultural sector (e.g., rock phosphate). Social inequality has continued to rise together with international migration. Finally, the current overconnected, globalized world has suffered a global health epidemic in the form of coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

These trends clearly show that our society deserves a new growth model since the current one, based on mass consumption, threatens sustainable societies in their widest sense. Many countries are aware of this issue and the United Nations have defined 17 Sustainable Development Goals (SDGs) and 169 target actions for the year 2030, among which no poverty, zero hunger, good health and well-being, quality education, gender equality, climate action, life below water and life on land are all important elements.

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[1] United Nations, *World population Prospects 2019* (United Nations Department of Economic and Social Affairs, 2019), https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf.

[2] Juan J. González-Alemán et al., "Potential increase in hazard from Mediterranean hurricane activity with global warming," *Geophysical Research Letters 46,* no. 3 (2019): 1754-1764.

[3] Jurriaan M. De Vos et al., "Estimating the normal background rate of species extinction," *Conservation biology* 29, no. 2 (2015): 452-462.

[4] Mehmet İlhan İlhak et al., "Experimental study on an SI engine fuelled by gasoline/acetylene mixtures," *Energy* 151 (2018): 707-714.

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Furthermore, digital technologies (e.g., 3D printing, advanced robotics, autonomous vehicles, and the Internet of Things), new materials (e.g., bio- and nano-based) and new processes (e.g., data driven production, artificial intelligence, synthetic biology) are completely changing how foods, products, and services are produced, distributed, sold and used in the world.[5] This has profound implications for the primary (mining and agricultural activities), secondary (manufacturing and biomedical industrial activities), and tertiary (services) sectors.[6,7] Scholars, practitioners and policy makers have therefore started to devote significant attention to this phenomenon, which has been referred to as digitalization, smart agriculture/smart farming, synthetic biology, or bio-inspired manufacturing, depending on the application context. While technological issues were initially considered the key element for the successful transition towards the above-mentioned paradigms,[8,9] recent studies acknowledged that employees' skills and organizational aspects are even more relevant.[10,11,12] We live indeed in exceptional and exponential times:[13] the amount of new technical information is doubling every two years; between 15,000 and 18,000 new species are identified each year;[14] according to the former US Secretary of Education, Richard Riley, the top ten most-in-demand

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[5] OECD, 2017. The Next Production Revolution: Implications for Government and Business. OECD Publishing, Paris.

[6] Alejandro Germán Franka et al., "Industry 4.0 technologies: Implementation patterns in manufacturing companies," *International Journal of Production Economics 210* (2019): 15-26.

[7] Pablo J. Zarco-Tejada, Neil Hubbard, and Philippe Loudjani, *Precision Agriculture: An Opportunity for EU Farmers—Potential Support with the CAP 2014-2020* (Joint Research Centre of the European Commission, 2014), http://www.europarl.europa.eu/RegData/etudes/note/join/2014/529049/IPOL-AGRI_NT%282014%29529049_EN.pdf.

[8] Jay Lee, Behrad Bagheri, and Hung-An Kao, "A cyber-physical systems architecture for industry 4.0-based manufacturing systems," *Manufacturing Letters 3* (2015): 18-23.

[9] Yufeng Ge, J. Alex Thomasson, and Ruixiu Sui, "Remote sensing of soil properties in precision agriculture: A review," *Frontiers of Earth Science* 5, no. 3 (2011): 229-238.

[10] Dominik T. Matt et al., "Urban production–A socially sustainable factory concept to overcome shortcomings of qualified workers in smart SMEs," *Computers & Industrial Engineering*, *139* (2020): 105384.

[11] Silvia Fareri et al., "Estimating Industry 4.0 impact on job profiles and skills using text mining," *Computers in Industry* 118 (2020): 103222.

[12] Alok Raj et al.,"Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective," *International Journal of Production Economics* 224 (2020): 107546.

[13] Karl Fisch, Scott McLeod, and Jeff Brenman, *Did you know; Shift happens-Globalization; information age* (2015).

[14] Benoît Fontaine et al., "New species in the Old World: Europe as a frontier in biodiversity exploration, a test bed for 21st century taxonomy," *PLoS One* 7, no. 5 (2012): e36881.

jobs in 2010 did not exist in 2004, and today's learners will have changed jobs 10 to 14 times by the age of 38.[15] The current scenario is completely changing the needs of different professional groups as well as the skills required by them. Scholars argue that in general (a) low skill jobs are likely to be replaced by automation; (b) more skilled workers will be needed to manage automated processes; and (c) new jobs will emerge, such as data analysts, geospatial information systems experts, as well as new types of human resources and organization development specialists.[16,17]

This poses significant challenges for the training of future employees as well as to re-skill current workers through lifelong learning programs. In addition, the characteristics of the learners have also changed, requiring a prompt resetting of the course structures and teaching approaches. In 2018/2019, the first *Generation Z* students obtained their master's degrees, while in 2028 the first Generation *Alpha* students will enter the HE system.

The context presented above poses two significant questions for the technical-scientific[18] Higher Education (HE) system: (1) are current study programmes in this field suitable to prepare students for their professional future and (2) are they adequately directed at the future characteristics and needs of current and new generations of students (Generations Z and *Alpha*)?

This paper seeks to start answering these questions by (1) analyzing the professional figures and the skills required by the job market, as well as the number of students enrolled in technical-scientific HE study programs with a focus on the top five European countries by Gross Domestic Product - GDP (i.e., Germany, UK, France, Italy, Spain) (Section II); (2) presenting the characteristics of the future students and discussing how the teaching tools and methods enabled by digitalization might contribute to increasing the effectiveness of training such students; and (3) shedding light on the different types of HE study programs (Bachelor's and Master's degrees, professional and multi-disciplinary degrees, dual study programs, post-secondary non-

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[15] Ola Erstad, "Educating the digital generation," *Nordic Journal of Digital Literacy* 5, no. 1 (2010): 56-71.

[16] Anne Bremer, "Diffusion of the "Internet of Things" on the world of skilled work and resulting consequences for the man-machine interaction," *Empirical Research in Vocational Education and Training* 7, no. 8 (2015).

[17] World Economic Forum, *The Future of Jobs. Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution* (2016), http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf.

[18] With technical-scientific, we mean the following ISCED Field of Education and Training (UNESCO, 2015): natural sciences, mathematics and statistics (code 05); Information and Communication Technologies (code 06); Engineering, manufacturing and construction (code 07); and Agriculture, forestry, fisheries and veterinary (code 08).

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tertiary programs, distance/blended learning, and lifelong learning) that can meet the educational challenges of the future (Section IV). Based on these analyses, we then identify a set of issues that should be considered by HE institutions, students, and policy makers to improve the efficiency and the effectiveness of the HE system (e.g., increase the number of graduates, prepare students for the jobs of the future based on disruptive paradigm changes in science and technology, and adequately leverage new teaching tools and methods), thus significantly contributing to the development of HE in both its theory and practical components.

II. Job market and current students

In Europe it has been forecast that in the next few years there will be a decrease in employment for people with low qualification levels and a simultaneous increase in employment for workers with higher education levels (i.e., Bachelor's and Master's studies) for different scientific and technical occupations (see Table 1). This skill shortage and skill mismatch are issues that have been analyzed and discussed in detail in the literature.[19,20]

Table 1

Forecast employment changes in Europe by occupation (percentage change)

Occupation	Forecast Employment Change (2015 to 2025)		
	Education level		
	Low	Medium	High
Production and specialized services managers	-0.4%	0.2%	0.7%
Science and engineering professionals	0.2%	0.7%	0.9%
Business and administration professionals	-0.2%	0.8%	1.0%
Information and communications technology professionals	-0.4%	0.6%	1.0%

[19] Giorgio Brunello and Patricia Wruuck, "Skill shortages and skill mismatch in Europe: a review of the literature" (IZA Discussion Paper No. 12346, 2019)..

[20] Kea Tijdens, Miroslav Beblavý, and Anna Thum-Thysen, "Skill mismatch comparing educational requirements vs attainments by occupation," *International Journal of Manpower* 39, no. 8 (2018): 996-1009.

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Occupation	Forecast Employment Change (2015 to 2025)		
	Education level		
	Low	Medium	High
Information and communications technicians	-0.3%	0.6%	1.1%
Market-oriented skilled agricultural workers	-0.5%	0.6%	1.8%
Market-oriented skilled forestry, fishery and hunting workers	-0.4%	0.8%	1.5%
Health professionals	-0.3%	0.5%	1.1%
Health associate professionals	0.6%	1.5%	1.6%

Qualification level (1) low: ISCED 1-2, (2) intermediate: ISCED 3-4, (3) high: ISCED 5-6.

Note that these forecasts did not include the effects of Brexit or the Covid-19 pandemic.

Source: Cedefop[21]

The evolution of jobs, skills and competences required by such trends as digitalization, smart agriculture and synthetic biology is therefore receiving increasing attention from both academics and practitioners.[22,23,24] In this new context, in order to successfully perform their tasks, employees must be able to adapt to new roles, activities and scenarios[25,26] and this has consequently changed the skills required by the job market for the new workforce. In this regard, while new and deeper technical skills are needed to deal with the latest automation and digital technologies,[27] soft skills, including social and personal skills, are becoming increasingly important to manage the complexities of the work place and to quickly adapt to the frequent changes

[21] Hanbury, Prosser, and Rickinson, "The differential impact", 469-483.

[22] Lara Bartocci Liboni et al., "Smart industry and the pathways to HRM 4.0: implications for SCM," *Supply Chain Management: An International Journal* 24, no. 1 (2019): 124-146.

[23] Carl Marnewick and Annlizé L. Marnewick, "The Demands of Industry 4.0 on Project Teams," *IEEE Transactions on Engineering Management* 67, no. 3 (2020): 941 - 949.

[24] Mirjana Pejic-Bach et al., "Text mining of industry 4.0 job advertisements," *International Journal of Information Management* 50 (2020): 416-431.

[25] Markus Lorenz et al.,*Man and machine in industry 4.0*. (The Boston Consulting Group, 2015).

[26] Liboni et al.,"Smart industry," 124-146.

[27] Marta Pinzone et al., *Jobs and skills in Industry 4.0: an exploratory research*, in: "IFIP International Conference on Advances in Production Management Systems" (Cham: Springer, 2017), 282-288.

in labor markets.[28],[29] There is a significant amount of research dealing with the optimal set of skills that new graduates should possess to be competitive in the job market and these studies often differ in terms of field of education, industry, data collection methods and skills classification.[30,31,32] However, it is possible to identify a set of core or basic skills that are common to many studies, and we have summarized these in Table 2. It is worth underlining that some of the referenced studies do not explicitly refer to digitalization, smart agriculture or synthetic biology and they simply talk about new skills required nowadays by companies/farms, but they still represent an important source for our discussion.

In line with other analyses, we classified the identified skills into four categories: technical, methodological, personal and social.[33,34,35]

1) ***Technical skills*** represent a "must have" and this includes the digitalization scenario[36] and they reflect the specific knowledge required in a certain domain[37]. As underlined by Pejic-Bach,[38] a peculiarity of the digitalization context is the multidisciplinarity of skills and knowledge that is required to the new workforce, which needs to possess not only the most traditional skills in a specific area, but also more advanced knowledge related to the new technologies (including information and communication technologies).
2) ***Methodological skills*** refer to the abilities of decision-making and problem solving,[39] as well as critical thinking and analytical skills,

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[28] Lorenz et al., *Man and machine in industry 4.0*.

[29] Chiara Succi and Magali Canovi, "Soft skills to enhance graduate employability: comparing students and employers' perceptions," *Studies in Higher Education* 45, no. 9 (2019): 1-14.

[30] Fátima Suleman, "The employability skills of higher education graduates: insights into conceptual frameworks and methodological options," *Higher Education* 76, no. 2 (2018): 263-278.

[31] Mercedes Teijeiro, Paolo Rungo, and Mª Jesús Freire, "Graduate competencies and employability: the impact of matching firms' needs and personal attainments," *Economics of Education Review*, 34 (2013): 286-295.

[32] Martin Humburg and Rolf van der Velden, "Skills and the graduate recruitment process: evidence from two discrete choice experiments," *Economics of Education Review*, 49 (2015): 24-41.

[33] Fabian Hecklau et al., "Holistic approach for human resource management in Industry 4.0," *Procedia CIRP* 54 (2016): 1-6.

[34] Liboni et al., "Smart industry," 124-146.

[35] Succi and Canovi, "Soft skills," 1-14.

[36] Pinzone et al., "Jobs and skills," 282-288.

[37] Marnewick and Marnewick, "The Demands of Industry 4.0".

[38] Pejic-Bach et al., "Text mining of industry 4.0 job advertisements," 416-431.

[39] Hecklau et al., "Holistic approach," 1-6.

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namely the ability to examine and structure a large amount of information.[40]

3) ***Personal skills*** represent individual abilities, attitudes and resilience.
4) ***Social skills*** reflect relational aspects and issues related to working and collaborating with colleagues.[41,42,43]

These last aspects are very important when an interdisciplinary approach needs to be applied in order to solve complex problems/issues. For a recent literature review on 21st century and digital skills, the interested reader might also see Van Laar.[44]

Table 2

Skills required in the future job market

Category	Skill	Exemplary references
Technical	Technical skills	
Methodological	Problem solving	Hecklau et al. (2016); Cacciolatti et al (2017); Easterly et al. (2017); Marnewick and Marnewick (2020); Peña Miguel et al. (2020)
	Analytical skills	Hecklau et al. (2016); Cacciolatti et al (2017); Suleman (2018); Succi and Canovi (2019)
	Critical thinking	Cacciolatti et al., 2017; Easterly et al. 2017; Suleman, 2018; Marnewick and Marnewick, 2020
	Decision making	Hecklau et al. (2016); Easterly et al. (2017); Succi and Canovi (2019)
Personal	Flexibility	Hecklau et al. (2016); Easterly et al. (2017); Liboni et al. (2019)
	Learning skills	Hecklau et al. (2016); Suleman (2018); Succi and Canovi (2019); Liboni et al. (2019)

[40] Succi and Canovi, "Soft skills," 1-14.
[41] Hecklau et al., "Holistic approach," 1-6.
[42] Suleman, "The employability skills," 263-278.
[43] Liboni et al., "Smart industry," 124-146.
[44] Estervan Laar et al., "The relation between 21st-century skills and digital skills: A systematic literature review," *Computers in human behavior 72* (2017): 577-588.

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Category	Skill	Exemplary references
Personal	Resilience	Liboni et al. (2019)
	Ability to work under pressure	Hecklau et al. (2016); Succi and Canovi (2019); Liboni et al. (2019)
Social	Communication skills	Hecklau et al. (2016); Cacciolatti et al (2017); Easterly et al. (2017); Suleman (2018); Succi and Canovi (2019); Liboni et al. (2019); Marnewick and Marnewick (2020)
	Teamwork	Hecklau et al. (2016); Cacciolatti et al (2017); Easterly et al. (2017); Suleman (2018); Succi and Canovi (2019); Liboni et al. (2019); Marnewick and Marnewick (2020); Peña Miguel et al. (2020)
	Leadership skills	Hecklau et al. (2016); Cacciolatti et al (2017); Succi and Canovi (2019); Liboni et al. (2019); Marnewick and Marnewick (2020)

Some additional observations can be made by looking at the number of students enrolled in HE programs. While the EU has achieved its general 2020 goal of raising the rate of tertiary educational attainment to at least 40% of the population who are aged 30-34, some EU countries (e.g., Italy, Germany, Romania, Portugal, Bulgaria, Czech Republic) are still significantly below this threshold.[45] Tables 3 and 4 show the number of students enrolled in Bachelor's (Table 3) and Master's (Table 4) degrees in the top five European countries by GDP (i.e., Germany, UK, France, Italy, Spain) in the period 2013-2017, focusing on four technical-scientific subject areas: (1) Natural sciences, mathematics and statistics (SCI), (2) Information and Communication Technologies (ICT), (3) Engineering, manufacturing and construction (ENG), (4) Agriculture, forestry, fisheries and veterinary (AGR). The gender issue is represented in the two tables by the percentage values shown in brackets (% of male students enrolled in each area).

In considering the data in Tables 3 and 4, it emerges that there has been a substantial increase in the enrollment of ICT students, in both Bachelors' and

[45] European Union, Education and Training Monitor 2019, https://ec.europa.eu/education/sites/education/files/document-library-docs/volume-1-2019-education-and-training-monitor.pdf.

Masters' studies, and this clearly reflects the need for deep ICT capabilities in the technological job market of nowadays.[46] An increase in the enrollments, although smaller, can be seen also in the agricultural sector, where a higher level of education increase is predicted by 2025 (see Table 1). Different situations are instead characterizing the SCI and ENG sector. As regards the former, we observe an increase in students at the Bachelors level and a decrease at the Masters level. This pattern can be reasonably ascribed to different causes. In fact, it may be that a Bachelor's degree in such subject areas, which provides deep analytical and problem-solving skills especially for mathematics and statistics, is sufficient to find an appropriate job and it does not motivate students to continue their educational programs. On the other hand, it may also represent a new trend characterized by an enrollment growth that has not been evident in Masters studies yet. As regards the engineering sector, the enrollment of students slightly decreased in both Bachelor and Master studies. This is quite surprising not only because such studies provide many technical skills required by the job market, but also because they should help students develop all the other soft skills shown in Table 1, in particular those related to problem solving, analytical and critical thinking.

With respect to the gender balance of students, it varies across subject areas, countries, and levels of education (see Table 3 and 4). At the Bachelors level, male students prevail in the five technical-scientific areas considered (with the exception of AGR in the UK), while, if we consider all students/programs, there is a slight prevalence of females (with the exception of Germany). The most unbalanced subject areas are ICT and ENG, with an average of 83% and 77% of male students, respectively. At the Masters level, the presence of males is still prevalent in ICT and ENG areas, while in the other areas the situation is balanced (SCI) or unbalanced towards females (AGR). No significant changes between 2013 and 2017 can be observed.

The different analyses presented above highlight a set of significant issues that in our view deserve to be carefully considered by HE institutions, students, and policy makers. First, *there is a significant need of more graduates (both Bachelors and Masters) and trained people*. While this need exists both in Europe and the USA, it is stronger in some European countries (in particular Italy, Germany, Romania, Portugal, Bulgaria, Czech Republic). The reasons behind the differences among the different countries may be due to (1) the initial situation, (2) the study programs that do or do not meet the needs/expectations of the students or of the job market, (3) cultural aspects, (4) demographic changes, or (5) other reasons.

[46] Liboni et al., "Smart industry," 124-146.

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Table 3

Students enrolled in Bachelor's degrees in technical-scientific fields (in brackets the percentage of males)

	Total[47]		SCI		ICT		ENG		AGR	
	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017
Germany	1,635,907 (56%)	1,859,807 (54%)	134,350 (58%)	155,769 (56%)	121,792 (82%)	158,654 (79%)	421,109 (82%)	439,879 (79%)	22,987 (66%)	24,642 (64%)
Spain	1,085,012 (46%)	1,211,630 (46%)	57,668 (50%)	83,193 (51%)	44,226 (86%)	44,869 (88%)	174,831 (74%)	154,760 (75%)	13,283 (66%)	11,343 (67%)
France	931,748 (42%)	1,041,756 (41%)	n.a.	n.a.	22,165 (89%)	25,800 (87%)	n.a.	n.a.	1,480 (56%)	1,030 (56%)
Italy	1,108,260 (45%)	1,102,137 (46%)	101,727 (41%)	101,157 (43%)	20,975 (87%)	25,251 (88%)	192,313 (73%)	180,547 (75%)	29,967 (55%)	34,655 (55%)
United Kingdom	1,526,720 (45%)	1,597,284 (44%)	n.a.	n.a.	66,940 (84%)	79,449 (85%)	n.a.	n.a.	14,071 (30%)	14,694 (26%)
TOTAL	6,287,647 (47%)	6,812,614 (47%)	293,745 (51%)	340,119 (51%)	276,098 (84%)	334,023 (83%)	788,253 (78%)	775,186 (77%)	81,788 (55%)	86,364 (54%)
		+8.35%		+15.79%		+20.98%		-1.66%		+5.59%

Note: n.a. stands for data not available.

Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enrt03&lang=en.

[47] Total number of students enrolled in Bachelor's degrees in all fields (not only technical-scientific).

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Table 4

Students enrolled in Master's degrees in technical-scientific fields
(in brackets the percentage of males)

	Total[48]		SCI		ICT		ENG		AGR	
	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017
Germany	930,366 (46%)	1,033,258 (47%)	110,178 (49%)	112,032 (50%)	34,627 (84%)	45,040 (80%)	120,561 (75%)	153,717 (75%)	13,269 (33%)	15,545 (37%)
Spain	514,369 (45%)	334,537 (42%)	28,630 (46%)	9,061 (52%)	11,756 (84%)	6,702 (80%)	88,027 (64%)	55,419 (62%)	14,016 (41%)	11,911 (35%)
France	831,956 (47%)	922,890 (47%)	n.a.	n.a.	26,469 (81%)	32,796 (82%)	n.a.	n.a.	10,525 (37%)	10,487 (37%)
Italy	727,019 (40%)	696,171 (41%)	29,064 (43%)	34,773 (42%)	3,879 (80%)	3,435 (82%)	111,136 (62%)	102,475 (64%)	15,244 (43%)	14,208 (42%)
United Kingdom	423,592 (42%)	434,851 (40%)	n.a.	n.a.	12,023 (77%)	12,619 (73%)	n.a.	n.a.	2,770 (40%)	4,052 (37%)
TOTAL	3,427,302 (44%)	3,421,707 (44%)	167,872 (47%)	155,866 (48%)	88,754 (82%)	100,592 (80%)	319,724 (68%)	311,611 (69%)	55,824 (39%)	56,203 (38%)
		-0.16%		-7.15%		+13.34%		-2.54%		+0.68%

Note: n.a. stands for data not available.

Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enrt03&lang=en.

[48] Total number of students enrolled in Master's degrees in all fields (not only technical-scientific).

Second, *there is a significant need of more graduates (both Bachelor and Master) and trained people in the fields/disciplines that are in higher demand by the job market,* which is changing/evolving at a very rapid rate. This is therefore a continuous challenge, which depends not only on the match between the job market and the HE study programs, but also on the attractiveness to students of the HE study programs.

Third, *there is a significant need for more graduates (both Bachelor and Master) and trained people with the "right" set of competences, i.e., both technical or domain specific and "soft" skills (methodological, personal and social)*. While traditionally the soft skills have been considered as subordinated to the technical or domain specific skills, the recent trends (such as digitalization, smart agriculture and synthetic biology) and the rapidly evolving job market have made these skills fundamental. This opens up the following question: do the current study programs effectively provide the skills, tools, methodologies, and approaches required by the job market?

Finally, as shown in Table 3 and 4, *some subject areas (i.e., ICT and ENG) are characterized by a significant gender imbalance, in particular at the Bachelors level, which does not seem to have been reduced from 2013 to 2017*. How can this imbalance be leveled-off in the near future? Which policy interventions and awareness campaigns might be carried out? In order to analyze whether the HE system is able to adequately address the four needs identified above, we discuss the characteristics of the students and the "new" teaching tools and methods in Section III and the current HE programs in Section IV.

III. Characteristics of students, "new" teaching tools/methods and assessment

The generation theory proposes that the era in which people are born and grow up in determines their development and views of society and the world.[49],[50] Five generations have been recognized and are characterized by a set of distinctive features: (1) the *Baby Boomer* generation (born from 1946 to1964); (2) *Generation X* (born from 1965 to1980); (3) *Generation Y* (born from 1981 to 1994, also known as Millennials); (4) *Generation Z*

[49] William Strauss and Neil Howe, *Generations: The History of America's Future, 1584 to 2069* (New York: William Morrow & Company, 1991).

[50] Sezin Baysal Berkup, "Working with generations X and Y in *generation Z* period: Management of different generations in business life," *Mediterranean Journal of Social Sciences* 5, no. 19 (2014): 218-229.

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(born from 1995 to 2009); and *Generation Alpha* (born from 2010 to 2025). While HE professors and teachers – as well as many students of lifelong learning programs – belong to the *Baby Boomer, and X and Y Generations*, the current students of the HE system belong to *Generation Z*. This generation has the following characteristics:[51] (1) they are materially endowed and technologically saturated; (2) they are digital integrators (technology is integrated into almost all areas of their lives) or digital natives (i.e., "native speakers of the digital language of computers, communication, video games and the Internet");[52] (3) they are globally focused; (4) they are visually engaged (preferring to watch a video on a topic rather than reading a book or an article); and (5) they are socially defined (extensively connected to and shaped by peers). In contrast, the HE students of the near future (from 2028 onwards) will instead belong to *Generation Alpha*. While the features of this generation still need to be fully defined, scholars propose that they will be even more digitally connected and visual engaged, e.g., using smartphones, tablets and wearable devices more naturally, growing up with the familiar voices of Siri, Alexa, and Google Assistant, spending more time on devices than face-to-face social time, and using You Tube as a major outlet for self-education.[53],[54] In general, scholars argue that *Generation Z* and *Alpha* students "think and process information fundamentally differently from their predecessors".[55],[56],[57] These include: they are "multiprocessing" i.e., they do several things simultaneously; they learn at higher speeds, making random connections and processing visual and dynamic information more effectively; and they prefer discovery-based learning.[58]

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[51] Mark McCrindle, M. and Emily Wolfinger, *The ABC of XYZ: Understanding the global generations* (University of New South Wales, 2009).

[52] Sue Bennett, Karl Maton, and Lisa Kervin, "The 'Digital Natives' Debate: A Critical Review of the Evidence," *British Journal of Education Technology* 39, no. 5 (2008): 775-786.

[53] Tiziano Botteri and Guido Cremonesi, "Millennials e oltre!: Nuove generazioni e paradigmi manageriali" (Milano: Franco Angeli, 2019).

[54] Bruce I. Carlin, Li Jiang, and Stephen A. Spiller, "Millennial-style learning: Search intensity, decision making, and information sharing," *Management Science* 64, no. 7 (2018): 3313-3330.

[55] Marc Prenksy, "Digital natives, digital immigrants," *On the Horizon 9*, no. 5 (2001): 1–6.

[56] Ildikó Horváth, Innovative engineering education in the cooperative VR environment. In 2016 7th IEEE International Conference on Cognitive Infocommunications (CogInfoCom) (pp. 000359-000364), IEEE (2016).

[57] Arlene J. Nicholas, Preferred Learning Methods of *Generation Z*, Northeast Business and Economics Association 46th Annual Conference (2019).

[58] Bennett, Maton, and Kervin, "The 'Digital Natives' Debate", 775-786.

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As a consequence the HE systems has to cater for the coexistence of different generations of both teachers and learners with different characteristics, preferences, styles, and needs. This mix of Generations in HE institutions blurs the boundaries between Generations and is reflective of society in general, and presents challenges around issues of teaching and learning, and of expectations. HE institutions have recognized and are beginning to responding to these challenges. We observe a changing face of learning with less emphasis on information acquisition and more emphasis on understanding and decision making.[59] The HE system has adopted two paradigm shifts in the last few years: from *teaching* to *learning* (i.e., "teaching is valuable if and when it leads to learning, but not otherwise")[60] and also from *learning* to *learners*, focusing on individual students' progress through the curriculum and on individual differences among students, and developing learners that can keep learning for their lifetime. The second shift has been enhanced by the increasing adoption of the learning-by-doing approach, theorized by philosopher John Devey, which is based on the fact that students learn best when they are actively involved in meaningful and important tasks.[61] The two abovementioned paradigm shifts are increasingly important for preparing students for work and careers in which (a) jobs and the competences required are changing very rapidly,[62] and (b) information and knowledge is easily accessible *via* the Internet.[63] Despite the abovementioned changes, a large majority of HE institutions still rely mostly on the traditional frontal lecture model[64],[65] and this is probably because senior members of staff are from the *Baby Boomers* and *X Generations*.

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[59] Harvey Siegel, *Educating reason*. Routledge (2013).

[60] Robert B. Barr and John Tagg, "From Teaching to Learning: A New Paradigm for Undergraduate Education," *Change* 27, no. 6 (1995): 12-25.

[61] Ghassan Frache, Hector Nistazakis, and George S. Tombras, "Reengineering engineering education: developing a constructively aligned learning-by-doing pedagogical model for 21st century education", in *2017 IEEE Global Engineering Education Conference (EDUCON)* (IEEE, 2017), 1119-1124.

[62] Wim Westera, "Competences in education: a confusion of tongues," *Journal of Curriculum Studies* 33, no. 1 (2001): 75-88.

[63] Chong Siong Choy and Choi Yong Suk, "Critical factors in the successful implementation of knowledge management," *Journal of Knowledge Management Practice* 6, no. 1 (2005): 234-258.

[64] Gianni Barbato, Roberto Moscati, and Matteo Turri, "Is the role of academics as teachers changing? An exploratory analysis in Italian universities," *Tuning Journal for Higher Education* 6, no. 2 (2019): 97-126.

[65] Marco Ronchetti, "Using video lectures to make teaching more interactive", *International Journal of Emerging Technologies in Learning* 5, no. 2 (2010): 45-48.

A very wide set of teaching tools and methods, enabled by the digitalization, has also been tested or introduced in HE in recent years. Video-based learning (VBL) has a long history as a teaching tool. The first experiments were indeed carried out during the Second World War to train soldiers, and is currently very popular.[66] The effectiveness of this tool lies in the suggestion that students remember 10% of what they read, 20% of what they hear, 30% of what they see, and 50% of what they see and hear.[67] Even more effective, despite being less popular due to their higher implementation barriers (e.g., availability/suitability, resources required and risks), are serious games.[68,69] These games exploit the notion that (a) students remember 70% of what they say and write[70] and (b) motivated students achieve better results.[71] Similarly, e-learning tools can be used to enhance challenge-based learning, i.e., a teaching methodology that engages students to resolve real-world challenges. More recently, other technology-oriented teaching tools have been investigated. A technology with a very high potential to enhance teaching is augmented and virtual reality.[72] The ambition of this is to allow students to virtually walk through laboratories, factories, fields, and forests, and other geographical areas anywhere in the world. Similarly, eye-tracking has started to be employed in education to highlight cognitive load, detect behavioral response, and adapt presentation elements.[73] Teacherbots (virtual teaching assistants based on Artificial Intelligence)[74] also have great potential and most likely for online courses. However, while all the teaching tools and methods mentioned above have significant potential, they are still only used at an experimental level and mainly for productivity-enhancement (teaching

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[66] Ahmed Mohamed Fahmy Yousef, Mohamed Amine Chatti, and Ulrik Schroeder, "The state of video-based learning: A review and future perspectives," *International Journal on Advances in Life Sciences* 6, no. 3/4 (2014): 122-135.

[67] Edgar Dale, *Audiovisual Methods in Teaching* (New York: Dryden Press, 1969).

[68] Jonathan Lean et al., "Simulations and games: Use and barriers in higher education," *Active Learning in Higher Education 7*, no. 3 (2006): 227-242.

[69] Mehmet Kosa et al., "Software engineering education and games: a systematic literature review," *Journal of Universal Computer Science* 22, no. 12 (2016): 1558-1574.

[70] Dale, "Audiovisual Methods in Teaching".

[71] Rosemary Garris, Robert Ahlers, and James E. Driskell, "Games, motivation, and learning: A research and practice model," *Simulation & gaming*, 33, no. 4 (2002): 441-467.

[72] Rula Al-Azawi et al.,"Exploring the Potential of Using Augmented Reality and Virtual Reality for STEM Education", in *Learning Technology for Education Challenges: 8th International Workshop* (Springer, 2019), 36.

[73] Jonathan L. Rosch, and Jennifer J. Vogel-Walcutt, "A review of eye-tracking applications as tools for training", *Cognition, Technology & Work 15*, no. 3 (2013): 313-327.

[74] Maderer, J., "Artificial intelligence course creates AI teaching assistant" (Georgia Tech News Center, May 2016).

high number of students with few resources) rather than for pedagogical reasons.[75] Furthermore, challenges remain including (1) whether the new teaching tools and methods really do enhance the learning process at a large scale and (2) whether the teachers and professors – mostly belonging to the *Baby Boomers, Generations X* and *Y* – are able to exploit the potential of such new teaching tools and what training they require.

There are many tools and methods enabled by digitalization that might be beneficial for the efficiency and effectiveness of teaching. Let us think for instance of the use of augmented and virtual reality as well as simulation tools in clinical and medical training, to allow students to try different surgeries or other cares in a "protected" environment without any risks for the patients or the students themselves. While these new tools and methods are only adopted at an experimental level, and mostly by the professors who have developed them and have therefore the knowledge for using them in their teaching activities (e.g., computer science or artificial intelligence professors), we predict that they will be more widely adopted in the coming years.

Finally, distance learning and e-learning tools have been increasingly adopted by HE institutions all over the world[76] and this has accelerated at an unprecedented rate as a result of the Coronavirus pandemic. Some of the tools mentioned above for on-campus education, such as serious games, augmented and virtual reality, and virtual teaching assistants, might also be effectively employed in case of e-learning. Besides them, there are also tools more specifically designed for e-learning, such as dashboard applications,[77] microblogging platforms,[78] geoportals[79] and social networks.[80] Furthermore, a prominent role in this context is played by e-learning platforms, such as

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[75] Sian Bayne, "Teacherbot: interventions in automated teaching," *Teaching in Higher Education* 20, no. 4 (2015): 455-467.

[76] Asma Ali Mosa Al-araibi et al.,"A model for technological aspect of e-learning readiness in higher education," *Education and Information Technologies* 24, no. 2 (2019): 1395-1431.

[77] Katrien Verbert et al., "Learning analytics dashboard applications," *American Behavioral Scientist* 57, no. 10 (2013): 1500-1509.

[78] Martin Ebner et al., "Microblogs in Higher Education–A chance to facilitate informal and process-oriented learning?", *Computers & Education* 55, no. 1 (2010): 92-100.

[79] Marianna Sigala, "Investigating the role and impact of geovisualisation and geocollaborative portals on collaborative e-learning in tourism education," *Journal of Hospitality, Leisure, Sport & Tourism Education* 11, no. 1 (2012): 50-66.

[80] Eva Kassens-Noor, "Twitter as a teaching practice to enhance active and informal learning in higher education: The case of sustainable tweets", *Active Learning in Higher Education* 13, no. 1 (2012): 9-21.

Moodle (Modular Object-Oriented Dynamic Learning Environment), or by videoconference and online collaboration software, such as Microsoft Teams, Skype, or Zoom.[81] For a detailed review of e-learning and e-mentoring see papers by Rodriguez and by Tinoco-Giraldo and their colleagues.[82,83] While the restrictions during the COVID/19 pandemic have completely changed the education landscape (see the conceptual paper by Cesco and colleagues),[84] the use of the abovementioned tools – with the exception Moodle and its basic functions of an online repository – have been until recently mostly limited to online Universities.

One significant challenge for distance learning and e-learning tools within HE institutions is that *while the students are often ready to use the e-learning tools/methods, it is not always the case for the teachers/professors, who might not be able to effectively teach their technical or domain specific skills through these new tools*.

Taking into account the different generations of students and teachers/professors, we currently have *"digital immigrants"* (Baby Boomers, *Generations X* and *Y*) teaching *digital natives* (*Generations Z* and *Alpha*).[85] While this might not be a significant problem for the teaching of technical or domain specific skills, it is more problematic for the "soft" skills (methodological, personal and social) that have emerged to be particularly important skills for new graduates. This might also be one of the main reasons why some current HE programs tend to focus mostly on technical or domain specific skills and consider the "soft" skills as subordinated to them.

The challenge for the HE system is therefore to become better able to teach both technical (domain specific) skills and "soft" skills (methodological, personal and social) by considering the characteristics, needs, and expectations of the different generations of students and leveraging the new digitally enabled teaching tools and methods. This can be achieved only through Faculty/staff who understand the different generations and are able to use the abovementioned teaching tools to great effect. There is therefore a need to both

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[81] Dan Benta,, Gabriela Bologa, and Ioan Dzitac, 2014, "E-learning platforms in higher education. case study", *Procedia Computer Science* 31 (2014): 1170-1176.

[82] Helena Rodrigues et al., "Tracking e-learning through published papers: A systematic review," *Computers & Education 136* (2019): 87-98.

[83] Harold Tinoco-Giraldo, Eva María Torrecilla Sánchez, and Francisco José García-Peñalvo, "E-Mentoring in Higher Education: A Structured Literature Review and Implications for Future Research," *Sustainability* 12, no. 11 (2020): 4344.

[84] Cesco Stefano et al., "Higher Education in the First Year of COVID-19: Thoughts and Perspectives for the Future", *International Journal of Higher Education* 10, no. 3 (2021): 285-294.

[85] Prenksy, "Digital natives, digital immigrants".

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rejuvenate HE Faculty/staff and also to train the more senior teachers/professors who are, thanks to their experience, the ones with the stronger technical (domain specific) skills. This need is particularly significant in some European countries, such as Italy (see the detailed analysis carried out by Labini and Zapperi),[86] in which despite the requests and the declarations of policy makers, the average age of the academic staff is still high (35% of the Faculty are 55 or older).[87] The digitally enabled teaching tools and methods – as well as the different generational characteristics – might also be leveraged to increase the participation of female students in particular in ICT and ENG programs, where the gender imbalance is particularly poor (see Section II).

Finally, the definition of internationally recognized reference points (e.g., learning outcomes and competencies) for different subject areas – as well as of suitable approaches to assess them – is also particularly important for making HE programs comparable, compatible, and transparent across countries. In this respect it is worth mentioning the project *TUNING Educational Structures in Europe*, which has proposed an approach to (re-) design, develop, implement, and evaluate high-quality HE programs, ensuring standardization but at the same time also preserving the rich diversity of European HE systems.[88] This approach has been extensively applied in many subject areas both in Europe and around the world. The TUNING project defines *competencies* as qualities, abilities, capacities or skills that are developed by and that belong to the students, and *learning outcomes* as measurable results of a learning experience which allows us to ascertain to which level a competence has been obtained (or enhanced).[89] The Holistic assessment approach to fully acquire a competence foresees the three main aspects of knowledge, skills, and attitudes (or behaviors).[90] A similar standardization initiative – focused on the ENG area – is the EUR-ACE Accreditation proposed by the European Network for Accreditation of Engineering Education (ENAEE).[91]

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[86] Francesco Sylos Labini and Stefano Zapperi, *I ricercatori non crescono sugli alberi* (Gius. Laterza & Figli Spa., 2011).

[87] Eurostat, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do.

[88] Marja Kaunonen et al., "Tuning educational structures in Europe: Guidelines and reference points for the design and delivery of degree programmes in nursing. Tuning educational structures in Europe" (University of Groningen, 2018).

[89] Kees Kouwenaar, "Changing paradigms: towards competency-assessment in admission to master's programmes in Europe: a review," *Tuning Journal for Higher Education* 3, no. 1 (2015): 99-135.

[90] Julia González, J. and Robert Wagenaar, Tuning Educational Structures in Europe II. La contribución de las universidades al proceso de Bolonia. (University of Deusto Press, 2006).

[91] https://www.enaee.eu/eur-ace-system/.

IV. HE programs

At the core of HE systems are ***the "traditional" Bachelor's and Master's degrees*** (possibly followed by doctoral degrees) that follow the Bologna process on many European countries. Within the technical-scientific field, these degrees belong to the following thematic areas:[92] Natural Sciences, Mathematics and Statistics (biology, biochemistry, environmental sciences, natural environments and wildlife, chemistry, earth sciences, physics, mathematics, statistics); Information and Communication Technologies (computer use, database and network design and administration, software and applications development and analysis); Engineering, Manufacturing and Construction (chemical engineering and processes, environmental protection technology, electricity and energy, electronics and automation, mechanics and metal trades, motor vehicles, ships and aircraft, manufacturing and processing, food processing, materials, textiles, mining and extraction, architecture and town planning, building and civil engineering); and Agriculture, Forestry, Fisheries and Veterinary (crop and livestock production, horticulture, forestry, fisheries, and veterinary). The focus of these "traditional" degrees has evolved in the last few years and they now provide to students not only a deep knowledge of the relevant subject matters (see above), but also a set of transversal skills, that are recognized as being increasingly important in the current scenario (see Section II). These skills include the ability to analyze and evaluate data, critical thinking, problem solving, ethics, organizational & collaboration skills, independence, adaptability & resilience, and interpersonal skills.[93,94] While the knowledge of the subject matters can be primarily taught through *in classroom activities* (lessons and exercises), the other skills tend to be better acquired *outside the classroom*, e.g., during field/company visits, group work, internships, co-curricular experiences, and on-campus/off-campus jobs.[95]

Alongside the "traditional" Bachelor's and Master's degrees, which are usually focused on a specific thematic area, some Universities have launched

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[92] UNESCO Institute for Statistics. (2015). International Standard Classification of Education Fields of Education and Training 2013 (ISCED-F 2013): Detailed Field Descriptions.

[93] European Network for Accreditation of Engineering Education - ENAEE (2020), https://www.enaee.eu/eur-ace-system/standards-and-guidelines/#standards-and-guidelines-for-accreditat ion-of-engineering-programmes.

[94] Luis Mayor et al., "Skill development in food professionals: a European study," *European Food Research and Technology 240,* 5 (2015): 871-884.

[95] Adam Peck et al., "The co-curricular connection: The impact of experiences beyond the classroom on soft skills", *NACE Journal* 76, no. 3 (2016): 30-34.

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interdisciplinary and multidisciplinary programs. Some of these programs – such as management engineering, ecology, mechatronics, bioinformatics, agribusiness and public health – have been consolidated and are currently regarded as traditional programs. Others have been introduced more recently and are still at an experimental stage. Some interesting examples are represented by the degrees in medicine and biomedical engineering, in cyber physical systems, management and informatics, and digital art and technologies.[96]

To leverage these activities outside the classroom mentioned above, many European countries have launched a set of ***Higher Vocational Education and Training (VET) programs***, such as: post-secondary programs outside higher education at ISCED levels 4 or 5; qualifications acquired based on the recognition of non-formal and informal learning (e.g., Master craftsperson qualifications); and various continuing vocational education and training CVET programs outside the formal system.[97] In the five countries considered in this paper, examples of these programs are: the Higher National Certificates and Higher National Diplomas in UK; the Advanced technician certificate (BTS - *Brevet de technicien supérieur*) in France; the Higher technical institutes (ITS) in Italy; and the higher-level cycles of Professional Training leading to Higher Technician diploma in Spain.

Other ***Higher VET programs*** *in a broad sense*, which are formally part of the HE system, are also offered in most European countries. For example these can be short cycle higher education, professional bachelor's and professional master's degrees or dual studies programs at Bachelor or Master levels (or even at Doctoral level). Prominent examples of professional degrees are those offered by the German *Fachhochschulen* (or University of Applied Sciences).[98] Other countries – such as Italy[99] – have instead launched these programs only very recently (in academic year 2018-2019).

The goal of the higher VET programs (both in a strict and in a broad sense) is to offer a training that is more practically oriented and to attract students that are not interested in traditional Bachelor's and Master's

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[96] Nadezda Kunicina et al., "Student Engagement in Cross-Domain Innovation Development and Its Impact on Learning Outcomes and Career Development in Electrical Engineering", in *2019 IEEE Global Engineering Education Conference,* (IEEE, 2019), 661-668.

[97] Daniela Ulicna, Karin Luomi Messerer, and Monika Auzinger *Study on higher Vocational Education and Training in the EU* (European Union Directorate-General for Employment, Social Affairs and Inclusion, 2016).

[98] Guy Neave, "Foundation or Roof? The Quantitative, Structural and Institutional Dimensions in the Study of Higher Education", *European Journal of Education* 24, no. 3 (1989), 211-222.

[99] Lauree professionalizzanti (professionalizing bachelor degrees) introduced by the DM n. 987 of 12.12.2016.

degrees, providing them more advanced but still immediately useful and practical skills. While these programs might significantly contribute to address one of the issues identified in Section II (i.e., to increase the number of graduates and trained people), their impact in practice is still limited considering the number of students enrolled (the students of these programs are less than 15% of the number enrolled to Bachelor's degrees in Europe).[100]

Another very important set of VET programs is represented by the ***lifelong learning programs***. These are aimed at upskilling or reskilling employees during their working career. They have been long neglected by European Universities and mostly left to professional chambers or other training institutions, with some prominent exceptions (e.g., the Master in Business Administration). Only recently European universities have started to acknowledge the importance of these programs and to extend their teaching offer in this direction.[101] A key aspect in these programs is the recognition (or accreditation) of prior learning, which varies significantly across countries and HE institutions.

All the programs presented above might be offered both on campus and as distance/online learning. Full online Bachelor and Master degrees still represent a minority of HE programs in Europe and are often offered by online Universities. However, these full-online programs are gaining popularity in North America and Asia and are offered also by traditional HE institutions.[102] More popular all over the world are online VET programs as well as the Massive Open Online Courses (MOOCs), open-access online courses that allow unlimited (massive) participation.[103]

Finally, it is worth mentioning programs for ***training the trainers.*** All five countries analyzed in this paper have specific programs for training teachers at different levels from kindergarten to High School. However, little emphasis has been placed on the pedagogical training of University professors, lecturers and teachers, despite the paramount importance of this topic. A prominent exception is in the United Kingdom, where there is a long tradition of teaching development programs for new academic staff[104] and this is now increasing in other European countries.

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[100] Eurostat, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do.

[101] Nina Volles, "Lifelong learning in the EU: changing conceptualizations, actors, and policies," *Studies in Higher Education 41,* no. 2 (2016): 343-363.

[102] Olaf Zawacki-Richter and Adnan Qayyum, *Open and Distance Education in Asia, Africa and the Middle East: National Perspectives in a Digital Age* (Springer, 2019).

[103] Kaplan and Haenlein, "Higher education and the digital revolution", 441-450.

[104] Andria Hanbury, Michael Prosser, and Mark Rickinson, "The differential impact of UK accredited teaching development programmes on academics' approaches to

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In summary, while the current offering of HE programs is wide and varied, and is properly organized at multiple levels, most of the attention of HE institutions is currently still focused mainly on "traditional" Bachelor's and Master's degrees. This highlights certain issues and opportunities – in addition to those identified in Sections II and III – that should be considered by HE institutions, students, and policy makers.

First, the *current higher VET programs (both in a strict and in a broad sense) do not attract a significant number of students compared to traditional Bachelor's degree and, therefore, they do not significantly contribute to increasing the number of graduates and trained people*. This issue might be traced back to different factors (both internal and external) that deserve to be analyzed in detail. *Internal factors* include the low attractiveness of the current offer of VET programs among prospective students due to their narrow thematic or applied/practical focus, the low awareness of their existence, and the low number of VET programs (and related study places) currently offered. Moreover, the rather conservative nature that characterizes the academic environment, making it less inclined to provide new, innovative and progressive HE programs compared to the classic one (classical forms of Bachelors and Masters programs), certainly contributed to this limited diffusion of VET programs, at least at the University level. A further aspect that should be considered is related to which institutions should offer the VET programs, i.e., only Universities, only professional chambers/associations, only *ad-hoc* training institutions, all these actors separately, or all these actors together (through some forms of cooperation/joint-ventures). In this respect, it should be noted that Universities carry out not only didactic activities but also research and this allows them to be at the frontiers of knowledge in the different disciplines. Professional chambers/associations and *ad-hoc* training institutions cannot therefore in our view exclude Universities when designing and teaching VET programs without losing this novel knowledge which is the basis for cutting edge education. Other *factors external* to the VET programs – such as the employability and career development opportunities of graduates as well as the legislation and regulations – might also play a significant role in affecting the low intake/enrolment. It is worth noting that EU member states are considering the future of VET programs and their regulation, including as part of the Covid-19 recovery strategy.[105] In this respect, policy makers should consider:

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teaching," *Studies in Higher Education* 33, no. 4 (2008): 469-483.

[105] https://ec.europa.eu/education/policies/eu-policy-in-the-field-of-vocational-education-and-training-vet_en.

(1) a rationalization of VET qualifications to remove duplications, increase value to employers and individuals, and improve transparency and functionality; (2) a reorganization of them into clusters, routes or vocational pathways; (3) legal value of the degree and positioning with respect to a "traditional" HE degree; (4) a fine-tuning of the "direct" access path to the professions/job markets.[106]

Second, *European Universities have long neglected lifelong learning programs and have only recently started to acknowledge their importance*. Leaving these programs in the hands of professional chambers or other training institutions has some advantages (for instance it might contribute to ensure that the subjects taught are relevant/useful for the practice) but also some significant risks. First and foremost is the focus on the current, rather than future, needs of particular sectors or professions (rather than of the society as a whole). The reasoning concerning the need to involve Universities – whose mission includes not only teaching but also research (i.e., knowledge development) – in VET programs in order to transfer novel and cutting-edge knowledge applies also to lifelong learning programs.

Third, *online Bachelor and/or Master degrees represent a minority of HE programs in Europe and are mostly offered by telematic universities*. Considering the changing needs and characteristics of students presented in Chapter 3, and the trends in USA and Asia concerning online programs, European HE institutions should consider launching online study programs to expand their teaching offer and also to making some courses/modules available online to meet the needs of some categories of students (for instance working students or students living in remote areas). This might also contribute to achieving one of the goals highlighted in Chapter 2, i.e., to increase the number of graduates and trained people. However, this requires significant infrastructural investments, training of the teachers/professors, and re-thinking of teaching methods, formats, and activities. Particular attention must be devoted to the re-design of some training activities that currently require physical presence to develop critical practical skills (e.g., lab exercises and company internships).

Fourth, *while some training-the-trainers programs exist, insufficient emphasis is placed on the pedagogical training of HE teachers/professors in many countries*. This is critical and in particular considering the different generations of students and teachers and the "new" digitally enabled teaching

[106] Bridget Wibrow and Joanne Waugh, "Rationalising VET qualifications: selected international approaches" (Research summary, National Centre for Vocational Education Research, September 2020).

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methods/opportunities. HE institutions should therefore reflect on whether it would be appropriate to include some (mandatory) programs on pedagogical concepts and teaching methods for newly appointed teachers/professors. In addition, making some form of education training could be mandatory for those seeking promotions in their HE system.

V. Conclusions

In this paper we sought to answer two significant questions for the technical-scientific HE system: (1) are current study programs in this field suitable to prepare students for their professional future and (2) are study programs adequate to deliver the needs of the current and new generations of students (*generation Z* and *Alpha*)? To do this we carried out a set of different analyses.

We first considered the number of professionals and the skills required by the job market, as well as the number of students enrolled in technical-scientific HE study programs in the top five European countries by GDP. These analyses allowed us to identify three significant issues that should be considered by HE institutions, students, and policy makers: *(1) there is a significant need for more graduates (both Bachelor and Master) and trained people, (2) these graduates are needed in specific fields/disciplines according to the job market, and (3) that graduates require the "right" set of competences that are both technical, domain specific skills, and "soft" methodological, personal and social skills.*

We then discussed the characteristics of the different generations of students and of their teachers/professors, and the new teaching tools and methods enabled by technology. This allowed us to highlight the paradox that we currently have of *digital immigrants* teaching *digital natives* and that this can lead to problems particularly in the teaching of "soft" skills, as well as the fact that *the new tools and methods have so far mainly been adopted at an experimental level, by those who developed them, and are not widely used.*

Finally, we analyzed the different types of HE study programs offered by European universities and highlighted that: (1) the *current higher VET programs do not attract a significant number of students compared to traditional Bachelor's degrees; (2) European universities have neglected lifelong learning programs and have only started to acknowledge their importance and invest in them very recently;* and *(3) online Bachelors and Masters degrees represent a minority of HE programs in Europe and are mainly offered by telematic universities.*

All the challenges and reasonings for the HE system presented in this paper are part of a series of more general challenges (or paradoxes) that both our universities and our society is currently facing. These challenges can be connected with the UN Sustainable Development Goals (SDG) cited in the introduction section.

In summary, the HE system faces a twofold challenge: (1) developing novel knowledge through research activities and improving innovation, and (2) finding effective ways to transfer this knowledge to the students whose diversity is increasing and who have different and continuously changing needs and skills. This challenge is now more important than ever considering the disruptive paradigm in science and technology, the rapid evolution of the job markets and the emergence of new teaching tools and methods enabled by the digitalization. Considering its current status and the means at its disposal, we consider that many HE systems will successfully adapt to overcome these challenges.

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Science, Business, and Policy: A long-term reflection on multidisciplinary work-based learning in a master's track for societal integration of Science

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Abstract: A strong theoretical approach with a specific focus on disciplinary research characterizes the common science master's education in the Netherlands. However, a work-based learning (WBL) approach may as well be expedient and suitable for science education at master's level. In this paper, a case study is presented of a WBL-program designed for an academic setting: the one year Science, Business and Policy (SBP) master's track, offered at the Faculty of Science and Engineering of the University of Groningen. The paper describes the design and curriculum of the track, including its underlying theoretical framework, courses, multidisciplinary projects and work placements. Based on the SBP-track's design we identified six possible indicators of a successful elaboration of an academic WBL-program: the SBP-track 1) is designed in response to the Bologna process; 2) is offered fully within the curriculum of a master's program of a research university; 3) requires a sufficient academic level and disciplinary knowledge at entrée; 4) follows an educational project approach; 5) focuses on the integration and implementation of knowledge, and; 6) applies learning objectives that are specifically formulated to match the WBL educational method.

A directed content analysis of SBP work placements revealed an increase in the number of SBP-students between 2003 and 2019, with an overrepresentation of life

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science students, as well as a large variety of real-case problems addressed for both business and policy organisations diverse in sector, size and region. Students' grades showed a positive correlation between the initial theoretical preparation and the report made during the work placement. In conclusion, the societal interpretation of the Bologna process has been implemented successfully with SBP, by combining academic learning with gaining professional experience using a WBL-approach.

Keywords: Work-based learning; science, business and policy; curriculum design; science education; interdisciplinary integration; didactic model; work placement.

I. Introduction

The necessity to bridge the gap between science and society has become a growing insight of our time.[1,2] In this perspective we have seen increasing efforts to integrate academic learning and practice-based learning in the past decades.[3,4] For many universities science-based learning placements at an academic level in business and policy institutions are still a relatively new development. There is yet much to be learned about the determinants of quality and success for academic programs that offer and integrate such placements in their curriculum. In their literature review, Lester, Bravenboer and Webb[5] conclude:

> There are, however, few practically oriented accounts of how 'basic science' or discipline-based knowledge can be integrated with transdisciplinary workplace learning, particularly at the level of initial development.

In addition, the authors stress the need to evaluate work-integrated programs and its curricular models. Here, we present a case study of the

[1] Peter Agre and Alan I. Leshner, "Bridging Science and Society." *Science* 327 (February 2010): 921. https://doi.org/10.1126/science.1188231.

[2] Robert Wagenaar, *REFORM! TUNING the Modernisation Process of Higher Education in Europe: A Blueprint for Student-Centred Learning* (Groningen: University of Groningen, 2019), 194-197.

[3] Stan Lester and Carol Costley. "Work-based learning at higher education level: value, practice and critique", *Studies in Higher Education* 35, No. 5 (August 2010): 561. https://doi.org/10.1080/03075070903216635.

[4] Luigi F. Donà dale Rose and Anna Serbati, "20th Anniversary of the Bologna Declaration: From overview of processes to ongoing activities and experiences," *Tuning Journal for Higher education* 6, no. 2 (May 2019): 13-19. http://dx.doi.org/10.18543/tjhe-6(2)-2019pp13-19.

[5] Stan Lester, Darryll Bravenboer and Neville Webb, "Work-integrated degrees: context, engagement, practice and quality." *Quality Assurance Agency for Higher Education* (September 2016): 34. https://doi.org/10.13140/RG.2.2.35788.21129.

development of an academic work-based learning master's track that is developed for science students at the University of Groningen, the Netherlands. This work-based learning program (from now on WBL), the Science, Business and Policy (from now on SBP) track, is developed to prepare science students for a science career in business and/or policy.

First, as there is a need to acquire more knowledge about how successful scientific WBL-programs are developed,[6] the theoretical framework that was used to design the SBP-track, including its curriculum, is deliberated on. Second, there is a need for more comparable qualitative information on WBL-programs to collect more information on the determinants of quality and success for academic WBL-programs.[7] Therefore, using a directed content analysis, SBP alumni study records between the academic years 2003/2004-2019/2020 are investigated on several variables.

We begin the paper with defining the concept of WBL and placing it in the Dutch university context. After a detailed exposé of the build-up of the WBL master's track SBP we discuss the theoretical considerations and framework of the program, as well as the derived learning goals. The methodology section comprises of a description of the units of analysis and explains why we chose to carry out a directive content analysis in the context of this case study. The results section includes information on several components of alumni study records, like student background and grades. Finally, we discuss six important success factors of the SBP-track based on its design and curriculum, summarize and give (potential) explanations regarding the results of the study record analysis, and discuss future questions on research into academic WBL-programs.

This paper will lay the foundations for a future, more extended evaluation of the societal effectiveness of WBL-approaches that are applied at an academic level. This case study is part of a so-called design-based research program,[8] that also includes studies on academic professors' perceptions of the degree to which WBL-programs as SBP are perceived as academic; the implications of the SBP-track on alumni's quality perception and career development, and a study on the perceived usefulness of the SBP-track for its societal partners (i.e., work placement organisations).

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[6] Lester, Bravenboer and Webb, "Work-integrated degrees," 34, http://devmts.org.uk/wid.pdf.

[7] Lester, Bravenboer and Webb, "Work-integrated degrees," 34, http://devmts.org.uk/wid.pdf.

[8] Terry Anderson and Julie Shattuck, "Design-Based Research: A Decade of Progress in Education Research?" *Educational Researcher* 41, no. 1 (January 2012): 16–25, https://doi.org/10.3102/0013189X11428813.

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I.1. The concept of work-based learning in the Dutch university context

WBL is a term used for multiple types of education in different settings with different goals. Originally, the development of WBL was seen as a concept to lower costs of higher education. In its further development, mainly in the UK and Australia, WBL was also seen in the broader educational perspective of connecting science and society.[9] This interpretation comprised a twofold strategy: for students to obtain a better preparation for a science-based career outside academia and for societal institutions to obtain access to actual developments in science.[10] In this article we focus on education within a curriculum of a fulltime master's program on level 7 in the context of the European Qualification Framework. Post-graduate and adult education are excluded. To define WBL we adopt a definition that is commonly used in current projects of the European Union:[11]

> WBL is an educational strategy or approach that provides students with real-life work experiences to apply academic knowledge and understanding as well as subject related and generic skills and competences to develop employability skills and competences.

Internationally, there is a division within higher education on WBL described by Lester et al.:[12]

> The academic literature indicates continuing debate between 'intellectualist' and 'pragmatist' positions, and discipline-based and transdisciplinary orientations.

This division can also be recognized in the organisation of the Dutch educational system. In the Netherlands, traditionally there is a strong division between research universities, providing education on level 7 (master's) and universities of applied sciences, called institutes for higher education, providing education on level 5 (bachelor's). This division originated due to their own unique histories and development.[13]

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[9] David Boud and Nicky Solomon, *Work-based Learning: A New Higher Education?* (Buckingham: SHRE/OU Press, 2001).

[10] David Boud, Nicky Solomon and Colin Symes, "New Practices for New Times," *in Work-based Learning: A New Higher Education*?, ed. David Boud and Nicky Solomon (Buckingham: SHRE/OU Press, 2001), 3-17.

[11] "What is Work-based Learning (WBL),", WEXHE, accessed September 29, 2020, https://wexhe.eu/index.php/2017/05/09/what-is-work-based-learning-wbl/.

[12] Lester, Bravenboer and Webb, "Work-integrated degrees," 34, http://devmts.org.uk/wid.pdf.

[13] Egbert de Weert, "The Netherlands," in *International Handbook of Higher Education*, ed. James J.F. Forest and Philip, G. Altbach (Dordrecht: Springer, 2006), 899-918.

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Research universities are commonly seen as knowledge institutes where students are prepared for a career in science. Universities of applied sciences are institutes providing vocational higher education, aimed at a professional career outside academia.[14] This division in focus between Dutch universities led to research universities delivering graduates who are specialized in theoretical and research skills (intellectualist), whereas universities of applied sciences deliver graduates who are specialized in practical skills (pragmatist). In this way, the Dutch educational system's practices lead to the so-called 'theory and practice gap':[15,16] graduated students from research universities cannot properly link the disciplinary knowledge gained by following theoretical courses with experiences they gain by actual practice in the professional work field, while graduates of vocational education often lack disciplinary knowledge compared to their practical skills.

Over the past decades, the need in Dutch society for professionals who are specialized in theory and practice, for instance combining reflection on their own actions with applicable knowledge of the professional field, has grown considerably.[17,18] Brew[19] stresses that – internationally – institutes offering higher education should prepare students to deal with a fast-changing professional environment. As Barnett already stated in 1998, professionals should be able to deal with super-complex knowledge.[20]

Additionally, the Bologna Process, a large reform of the European educational system explicitly aimed at unifying European on policy and quality assurance in higher education, states that higher education in Europe should be based on research at all levels, and comparable criteria and methodologies should be established (e.g., facilitating the international

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[14] Didi M.E. Griffioen and Uulkje de Jong, "Opvattingen van Docenten en Niet-docenten over Onderzoek in Het Hbo," *Tijdschrift voor het Hoger Onderwijs* 28, no. 2, (January 2010): 83.

[15] Donald A. Schön, *The Reflective Practitioner: How Professionals Think in Action* (New York: Basic Books, 1983), 1-374.

[16] Donald A. Schön, *Educating the reflective practitioner* (San Francisco: Jossey-Bass Publishers, 1987), 1-355.

[17] Jacqueline. W.M. Hulst and Frans Leijnse, "De veranderagenda: de organisatie van het onderzoek in de hogescholen," *Tijdschrift voor Hoger Onderwijs en Management,* no. 1 (2007): 47-54, https://www.themahogeronderwijs.org/het-archief/author/3.

[18] Gerda Geerdink, Els van der Pool and Erik Jansen, "Onderzoek in het hbo op de lerarenopleiding primair onderwijs," *Tijdschrift voor Hoger Onderwijs en Management,* no 1 (2008): 56-61, https://www.themahogeronderwijs.org/het-archief/author/235.

[19] Angela Brew, "Transforming Academic Practice through Scholarship," *International Journal for Academic Development* 15, no 2 (June 2010): 105-116, https://doi.org/10.1080/13601441003737618.

[20] Ronald Barnett, "Supercomplexity and the university," *Social Epistemology* 12, no 1 (June 1998): 48, https://doi.org/10.1080/02691729808578859.

exchange of students).[21,22,23,24] In response to this, the universities of applied sciences in the Netherlands started to offer more discipline-based and theory-forming (i.e., research-based) programs. Dutch research universities started to narrow the theory and practice gap from the other end, by creating more professional preparation.

I.2. The development of the Science, Business and Policy track as a work-based learning program

The Bologna process has shaped and structured master's programs of Dutch research universities in several ways. For instance, the policy's aim of synchronizing curricula led Dutch research universities to decide that for Mathematics and Natural Sciences, instead of one-year master's programs, two-year master's programs should be designed, divided into three different orientations: a (traditional) research-, an educational-, and a societal-oriented master's track. The addition of a second master's year allowed for the development of new master's programs, without explicit competition with existing programs. The SBP-track is developed at the University of Groningen, the Netherlands, as a societal-oriented master's track with a WBL-approach. Hence, the Bologna process facilitated the option of offering WBL-oriented programs like the SBP-track fully within the curriculum of research universities.

At the University of Groningen, students can start a master's program when they have obtained a bachelor's degree in science at a research university. After the bachelor, students choose an academic discipline for their two-year master's program (e.g., biomedical sciences). In the first master's year, all students gain disciplinary competences and knowledge by following courses at master's level. In addition, in the first master's year students carry out a research project resulting in a master's thesis (minimum

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[21] Stanisław Juszczyk, "The Bologna Process and the European Higher Education Area," *Korean journal of European integration 7* (September 2013): 89-115.

[22] Ruth Keeling, "The Bologna Process and the Lisbon Research Agenda: the European Commission's expanding role in higher education discourse," *European Journal of Education* 41,no 2 (May 2006): 203-223, https://doi.org/10.1111/j.1465-3435.2006.00256.x.

[23] "Quality Assurance," EHEA, accessed September 29, 2020, http://www.ehea.info/pid34433/quality-assurance.html.

[24] "The Bologna Process 2020 - The European Higher Education Area in the new decade," Communiqué of the Conference of European Ministers Responsible for Higher Education, accessed September 29, 2020, https://www.eurashe.eu/library/modernising-phe/Bologna_2009_Leuven-Communique.pdf.

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of 30 ECTS). In the second master's year, students either choose a continuation of a traditional (research) track, the educational master's or alternatively the SBP-track. In this paper, we will not further elaborate on the educational track and compare the SBP-track exclusively with the research-track.

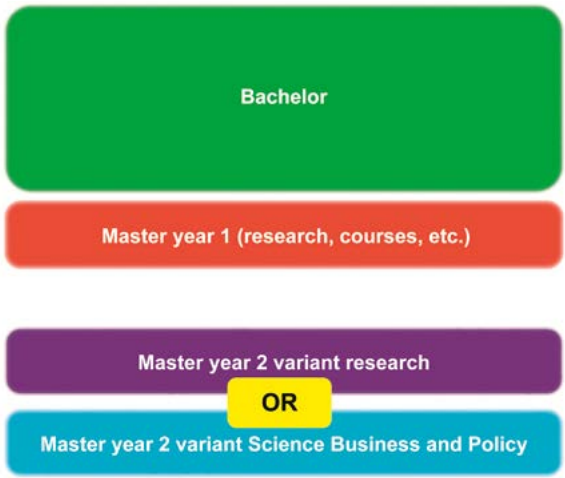

Figure 1

Curriculum design of science study programs of the Faculty of Science and Engineering at the University of Groningen

When students select the research-track, they take disciplinary courses together with other students from a similar disciplinary background. They continue to work on a research project and write a second year master's thesis. In addition, they write a short thesis, prepare and present a colloquium and follow disciplinary master's courses. Students following the research-track are specifically prepared for an academic research career (i.e., PhD-trajectory).

When students choose the SBP-track, they are grouped together with students from different disciplinary backgrounds within science. Students take master's courses on business and policy and gain professional experience during a work placement at a business, policy, or non-governmental organisation. Students learn to integrate their science background with some other new disciplines: business and public administration. The SBP-staff consists of a team of coordinating SBP-lecturers, supplemented with tutors,

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guest lecturers, senior academic science specialists and experts from business and policy institutions. This variety of stakeholders were involved from the initial development to the continuing improvement of the SBP-track. Hence, an interdisciplinary team in the SBP-track prepares students for a career at an academic level in a business, policy or non-governmental organisation. Despite its societal focus, after the SBP-track it is also possible to pursue an academic research career (i.e., this is the case for all level 7 academic tracks).

The SBP-track consists of two courses of both 10 ECTS and a work-placement trajectory of 40 ECTS. The first 10 ECTS course is 'Introduction to Science and Business', where students receive a theoretical crash course on business administration and innovation, including a theoretical exam. This is followed by a four-week real case group project – for a company - in which students integrate and apply their knowledge of corporate management with their scientific discipline. Here, students learn integrative competences and combine knowledge from their bachelor's and first master's year with general competences like personal development, project management, communication and soft skills (i.e., a combination of interpersonal and social skills).[25] The second course, 'Introduction to Science and Policy', has a similar set-up, focusing on policy skills. Students get a theoretical examination on public administration and finish a real case group project of four weeks for a governmental or non-governmental organisation.

The final and largest part of the SBP-track is an individual work placement of 40 ECTS (approximately six months), in which the work-based learning component is put into practice. The actual connection between science and business or policy is made during this fulltime business or policy work placement at an external organisation.

Figure 2

Program design of the Science, Business and Policy track

[25] Jami Dixon, Cody Belnap, Chad Albrecht and Konrad Lee, "The Importance of Soft Skills," *Corporate Finance Review* 14, no 6 (June 2010): 35.

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I.3. The Science, Business and Policy track's work placement

Before students start their six-month work placement, they follow a series of preparatory workshops on acquisition tools and career management (i.e., learning to construct proper resumes and application letters, practicing networking and applying for work placements). After successfully completing these workshops, it is the student's responsibility to find and apply for a work placement that fits their academic profile and personal preferences. In accordance with the work placement organisation, students formulate a work placement assignment. This assignment has to contain defined science aspects as well as business or policy aspects and has to result in a science advice report for the client that integrates and bridges theoretical (scientific) and practical (societal) aspects. These final reports have a similar status as a master's thesis - the final (research) report for students who follow a research-track. An advice report is considered to be academically sufficient when it: is based on an integration of scientific knowledge and business or public administration competences; contributes to solving real problems; creates real solutions in society, and; gives practical and implementable advice. During this advising process, the ideal attitude of the SBP-student towards the work placement organisation is to be connected but to stay independent and keep a critical attitude.

During the work placement, the students are supervised by three instructors. First, a daily supervisor at the work placement's organisation is responsible for general supervision. Second, there is a science supervisor from the university who is a specialist on the scientific aspect(s) of the assignment. Third, an SBP-supervisor who is a staff member of the SBP-track, guards the integration of the different disciplines. During the work placement, all instructors regularly contact the student and each other (i.e., at least once every 2 months).

In addition, there is one week prior to, one week during, and one week after the work placement when students have plenary education at the university:

1. Preparation week: before the work placement, students make an action plan and schedule for their work placement. In addition, students follow lectures on personal development, networking and organisational culture.
2. Midterm week: about 3 months into the work placement, all students - including students with a work placement abroad - return to the university to share experiences, reflect and if necessary, adjust their action plan.

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3. Closing week: after the work placement, all completed work placement advice reports are presented and shared during a three-day symposium visited by all supervisors and other interested parties (e.g., future SBP-students). This week usually couples to a career market where interested parties can meet.

II.1. Theoretical framework of the SBP-track

This section will outline the theories and models that were used to create the SBP-track and its curriculum. The Bologna Declaration and Social Constructivism as the basis of the overall design of the program are explained. In addition, choices with regard to curricular implementation are described, including the project approach, the loop model, and the business and policy cycle. Furthermore, the learning goals and competences of the SBP-track, based on Bloom's Taxonomy and the Dublin Descriptors, are presented.

From a theoretical perspective, the nature of the SBP-track of positioning science in a societal context, can be considered a contextual approach of learning. The track introduces business and policy concepts to science students, and provides specific tools for application in a work-based situation. This all fits in a model of competence-based learning of contextualized knowledge, inspired by the Bologna Declaration.[26,27] Individual development in learning is based on additional elements of the SBP-track such as differentiation in disciplinary background and personal preferences to operate in a specific societal context (commercial, governmental or other defined societal interests). Also, personal motivations and qualities may define roles in project management. Together, this asks for a corresponding educational psychology, combined with principles of social constructivism, from which the most important principle is that development takes place by social interaction.[28]

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[26] Wagenaar, *REFORM!,* 191-212.

[27] María José Bezanilla, Ana María García Olalla, Jessica Paños Castro and Manuel Poblete Ruiz, "A model for the evaluation of competence-based learning implementation in higher education institutions: Criteria and indicators," *Tuning Journal for Higher Education* 6, no. 2 (May 2019): 127-174, http://dx.doi.org/10.18543/tjhe-6(2)-2019pp127-174.

[28] Nicolás Marín, Alicia Benarroch and Jimenez E. Gomez, "What is the relationship between social constructivism and Piagetian constructivism? An analysis of the characteristics of the ideas within both theories," *International Journal of Science Education* 22, No. 3 (July 2010): 225-238, https://doi.org/10.1080/095006900289840.

In the SBP-track, a central element aimed at facilitating successfully completing the real-case group projects, and work placement success, is integrating the educational project approach as described by Bos and Harting,[29] and Bos, Harting and Hesselink.[30] The project approach focuses on working with project tools, working in project teams, managing the project environment, and personal leadership. This approach is chosen for several reasons. First, the approach provides tools to develop clear time paths and structural elements (e.g., project definition, plan of action and backward planning), as developed by Turner.[31] Second, running a complete project reflects the expected career path more realistically compared with walking along in existing work (Quality in Work-based Learning).[32] Third, managing a project creates student involvement, clear attributed achievements, and an active and responsible attitude.

II.1.1. The loop model

During the work placement, students use different tools (depending on the type and topic of their work placement) and combine these with their disciplinary knowledge and skills, in order to write a sufficiently grounded science advice report. The SBP-track is quite unique and specific, and as such, no science, business and policy knowledge integration tools were available at the time SBP started as a master's track. The SBP-track's staff created its own tool-integration model: the loop model (Figure 3), evolved from a first version developed in 2006 by Gerkema, Van der Windt and Karasek.[33],[34] The loop model is based on initial experiences as well as theoretical approaches from the field of science and business and policy

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[29] Jo Bos and Ernst Harting, *Projectmatig creëren (9th edition)* (Schiedam: Scriptum Books, 1998).

[30] Jo Bos, Ernst Harting and Marlet Hesselink, *Project Driven Creation* (Utrecht: Phaos, 2014).

[31] Rodney J. Turner, *The handbook of project based management (2th edition)* (London: McGraw-Hill, 1999).

[32] "*Quality Apprenticeships: A Manual for Educational Organizations* Version 1 Eurashe Report Brussels", ApprenticeshipQ, accessed November 20, 2020, https://apprenticeshipq.eu/.

[33] Menno Gerkema, Eva Karasek and Henny J. Van der Windt, "Loop model," in *Science, Business and Policy Reader*, ed. Gert-Jan W. Euverink (Groningen: University of Groningen, 2016).

[34] Menno Gerkema, "*Timing and innovation*", (Inaugural lecture, University of Groningen, Groningen, 2008).

integration (e.g., the Triple helix model).[35,36] The loop model describes a time path from the development of an innovation, starting at an initial idea and resulting in a plan to implement this idea. Often work placement tasks take place within this time path (Figure 3). Sometimes, work placements assignments fit better in loops after the implementation of an idea, for example an evaluation study of a product. In practice, the loop model is adjusted easily to the needs of differently phased projects.

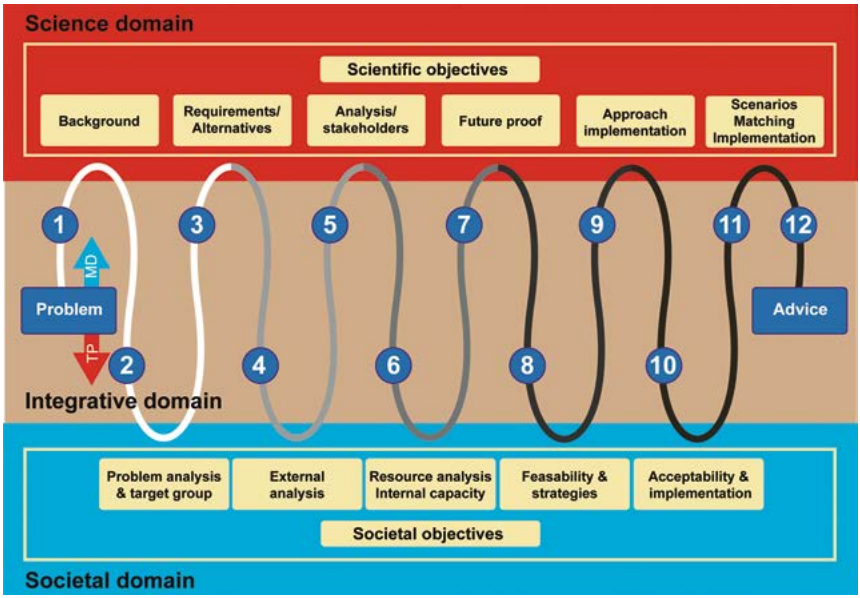

Figure 3

The loop model for integration of the science and technology domain with the societal domain

We explain the loop model from a business work placement perspective here. When a student uses the model for a business work placement, the student

[35] Loet. A. Leydesdorff and Henry Etzkowitz, "The Triple Helix as a model for innovation studies," *Science and Public Policy* 25, no. 3 (1998): 195-203, https://doi-org.proxy-ub.rug.nl/10.1093/spp/25.3.195.

[36] Loet. A. Leydesdorff and Henry Etzkowitz, "Emergence of a Triple Helix of University-Industry-Government Relations", *Science and Public Policy* 23, no. 5 (1996): 279-86, https://www.leydesdorff.net/th1a/.

starts with a Problem, and determines whether there is a Market Demand problem or a Technology Push. The nature of the problem decides whether the first loop will go up to the science domain, or down to the societal domain. For instance, in case of a market demand problem, the first matter that needs attention is what the current scientific possibilities are. In case of a technology push, the first step is determining whether (individuals in) society could be helped by, or are interested in this technology. The student then follows the loops and connects the science domain and the societal domain within every step. In the loops, several project phases are met. These phases are visible in the picture as numbers. The project phases they can encounter are thus: 1) Initial brainstorm; 2) Question Specification; 3) Problem Definition (concept); 4) Context & Solution; 5) Threats & Opportunities; 6) Resource Analysis; 7) Preliminary Conclusion; 8) Embedding; 9) Integration; 10) Action Plan, and; 11) Creating Commitment. During the courses' real case projects, student practice with all these phases by using them in lecture assignments.

The loop model can be adapted for business or policy projects by integrating different tools that are offered and explained to students in corresponding course lectures. In Figure 4, the societal domain of a business loop model, complemented with business tools in the societal domain as compiled from Johnson & Scholes[37] is shown.

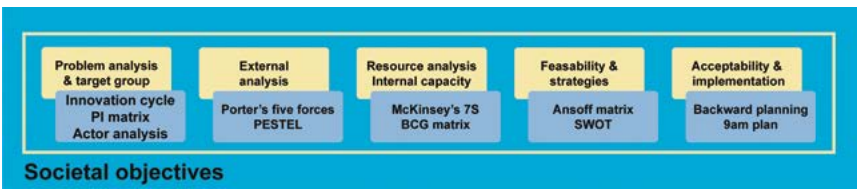

Figure 4

The societal domain of a business loop model, complemented with business tools

II.1.2. The business cycle and policy cycle

Supplementary to placing work placement assignments in the loop model, students have to position their work placement assignment in the

[37] Gerry Johnson and Kevan Scholes, *Exploring Corporate Strategy (6th Edition)* (Edinburgh Gate: Financial Times Prentice Hall, 2002), 1-1070.

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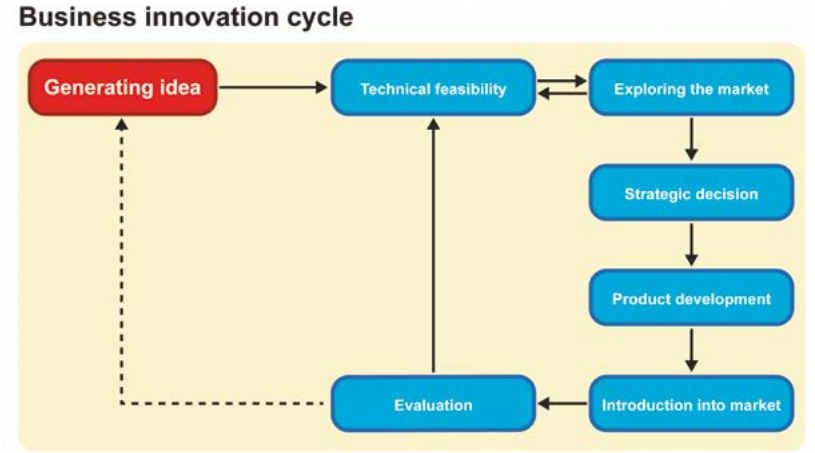

Figure 5

The business innovation cycle as employed in the SBP-track

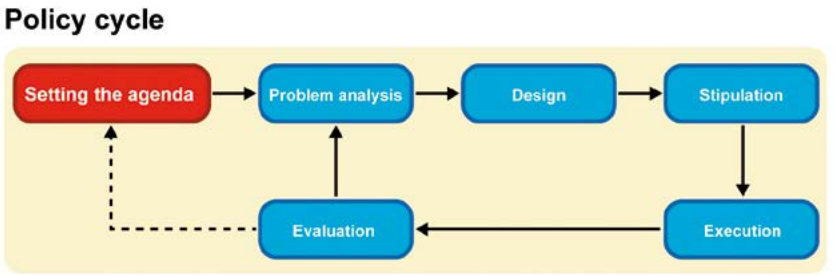

Figure 6

The policy cycle as employed in the SBP-track

business innovation cycle (Figure 5) or policy cycle (Figure 6). In their advice reports, they reflect on the impact of the position their assignment has in the cycle. The science advice can be given at all different stages in a business innovation or policy cycle. Some work placement assignments require advice on multiple stages of the cycle. The cycles have been explained to students during the business and policy courses and they practiced with those cycles during the real case projects. The business innovation cycle is based on the business innovation chain adapted after von

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Stamm[38] and Conway & Steward.[39] The cyclical approach is familiar to students as they have worked with the empirical cycle[40] in research courses and projects during their first master's year. Some of the essential underlying models for the policy cycle are the causal field model, the field process model and the policy tree model.[41] In Figure 6 the cyclic process shown is based on Howard,[42] Hoogerwerf and Herweijer[43] and Dunn.[44]

II.2. Learning goals and competences

The learning goals and competences of the SBP-track[45] are listed in Table 1. Originally, the Bloom taxonomy of general learning objectives,[46] was specified in an academic context in which learning skills address the capacity of independent learning in the so-called Dublin descriptors.[47] We translated these descriptors so that they fitted the WBL-approach and included science advising capacities. The prerequisite for science advising is having a certain expertise within a specific science area, in which at least all Bloom objectives and Dublin descriptors have been met. Students learn the

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[38] Bettina von Stamm, *Managing innovation, design and creativity* (Hoboken: John Wiley & Sons, 2008).

[39] Steve Conway and Fred Steward, *Managing and Shaping Innovation* (Oxford: Oxford University Press, 2009).

[40] Adrianus de Groot, *Methodology: Foundations of Inference and Research in the Behavioral Sciences* (Belgium: Mouton & Co, 1969).

[41] Johan. C. Coolsma and André J. G. M van Montfort, "De uitvoering van overheidsbeleid," in *Overheidsbeleid, Een inleiding in de beleidswetenschap*, ed Andries Hoogerwerf and Michiel Herweijer (Alphen aan den Rijn: Kluwer, 2014), 117-135.

[42] Cosmo Howard, "The policy cycle: A model of post-machiavellian policy making?" *Australian Journal of Public Administration* 64, no. 3 (September 2005): 3–13, https://doi.org/10.1111/j.1467-8500.2005.00447.x.

[43] Andries Hoogerwerf and Michiel Herweijer, *Overheidsbeleid: Een inleiding in de beleidswetenschap* (Alphen aan den Rijn: Kluwer, 2014).

[44] William N. Dunn, *Public policy analysis: An integrated approach* (New York, NY: Routledge, 2018).

[45] *"Work placement Business and Policy,"* University of Groningen, accessed April 09, 2021, https://www.rug.nl/ocasys/fwn/vak/show?code=WMSE901-40.

[46] Benjamin Samuel Bloom, "Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive domain," in *Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive domain,* ed. M. D. Engelhart, E. J. Furst, W. H. Hill and D. R. Krathwohl (New York: David McKay, 1956), 1-216.

[47] Bologna Working Group, *A Framework for Qualifications of the European Higher Education Area. Bologna Working Group Report on Qualifications Frameworks* (Copenhagen: Danish Ministry of Science, Technology and Innovation, 2005).

craft of science advising by additionally studying new knowledge areas concerning technology, business and policy administration, and innovation management. When students combine their scientific expertise with those new knowledge areas, it will lead to an integration of these knowledge domains and the distinction of societal values of science.

In our view, especially the last three learning objectives (4-6, Table 1), which lead to independent learning skills in science advising require additional skills and attitudes that are generally not seen as characteristics of science students. We experience these as being critical for strategic and effective advising and communication, for an entrepreneurial attitude, for leadership and team-playing capacities, and for reflection on the different roles a science student can play in the process of science advising. Together, these six learning objectives are formulated to facilitate an optimal preparation for a successful science advising, with all its specific demands.

Hence, these goals and competences are set up to ensure students are fully prepared for a career in business and/or policy. Furthermore, these learning goals form the basis of the grading criteria. The main element in the final grading of WBL is the science advice report that the SBP-student writes. The SBP-instructor grades this report with a rubric (containing criteria to score the learning goals) and gets input from the daily supervisor and the science instructor. The main difference between the learning goals of research-tracks and the SBP-track is that research-tracks spend additional attention to disciplinary specialization while the SBP-track has an interdisciplinary focus and includes more on general competences. The learning goals did not change over the years (2003-2020).

Table 1

Learning goals of the Science Business and Policy track

	Learning Goals
1	**Getting acquainted with business and policy sciences**
	Students are able to write an independent advice with concepts from business and public administration, innovation management and Science and Technology studies.
2	**Personal development**
	Students have the skills to do project work in a group and alone.
	Students are able to show leadership that fits their personality and the needs of the group.
	Students have insights in their own strengths and challenges.

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	Learning Goals
3	**Bridging fields of knowledge**
	Students are able to understand and to handle business and policy perspectives.
	Students are able to create synergy from multiple domains.
4	**Applications in social context**
	Students are able to judge their own discipline critically and in context to business or policy and society.
	Students are able to find a balance between the individual interest and the group interest.
	Students are able to act as a science adviser in an ethical way.
	Students know how to implement innovations in a sustainable way.
5	**Effective communication**
	Students are able to communicate in an effective way to target groups.
	Students are able to evaluate their advice so that it is implementable.
6	**Overall science advising**
	Students are able to consider their role(s) in science advising critically.

III. Alumni study records analysis

We describe the development of the student population and the background of 444 science alumni who finished the SBP-track during the first 16 years of its existence. In addition, using a directed content analysis, 289 study records of SBP alumni who graduated between the academic years of 2003/2004-2016/2017 were analysed on several other variables, including work placement characteristics and assignments, source and tool usage during the work placement. Students' grades on theoretical courses and science advice reports were explored for the academic years 2015/2016-2019/2020.

For each of the variables examined in this case study, we formulate what exactly we will examine, including potential outcome expectations:

1. Student population and background: we will examine how students are divided over the different science disciplines within the SBP-track. It is expected that biomedical science students form the largest

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group, since this is also the largest program within the faculty. Furthermore, biology students could be strongly represented because the origin of the SBP-track lies in biology. In principle, we expect the total population of students to grow due to increasing interest. This increased interest is not expected to be reflected reliably due to capacity limitations of the SBP-track. However, if the program is in line with the demand of society and the interest of the students, we would expect an overall increase in the number of students.

2. Work placement characteristics: we will study the distribution of the work placements' type, size, location and sector. We expect sector to correspond with student's academic background. In addition, we expect all characteristics to also correspond with personal preferences (i.e., due to the design of the program students may arrange their own placement), without a specific expectation of which is the most common.
3. Work placement assignments: we will analyse the distribution of the work placements' type of assignment, and stage of the innovation cycle and policy cycle it relates to. On one hand we expect an emphasis on the scientific aspects because this is in line with the paradigm of the science students (after four years of full focus on science during their studies). On the other hand: the type of assignment and position in the cycles depend on the requirements of the work placement. Hence, placements outside the loop model are also expected since stages from the innovation cycle that focus on execution, implementation and evaluation (see Figure 5) also occur in the workplace. No specific expectations are formulated for which type of assignment occurs most.
4. Source usage: we will examine how many literature references and external contacts students cite in their advice report. Since all SBP-students are at the end (i.e., last year) of their master's program, you expect a proficiency in literature search use and thereby adequate and sufficient references to scientific literature. Although science students are generally not trained in the use of external contacts as a source, SBP-students are during SBP-courses. That is why we also expect that students will be less reluctant to refer to at least some external contacts per placement. Given the large number of stakeholders in policy issues,[48] we expect more references to external contacts in policy placements than in business placements.

[48] Dirk-Jan F. Kamann, *Externe Organisatie: een inleiding vanuit een netwerkperspectief* (Groningen: Charlotte Heymanns Publishers, 2003), 1-301.

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5. Business, policy and loop model tools (absolute frequency): at the SBP-track, a variety of tools is offered, and we expect that the use of these tools fits the individual work placement and therefore will be very diverse. We also expect students to use the loop model but not every loop in every stage, as the work placement assignments can focus on one specific loop or a limited number of loops.
6. Work placement, business and policy grades: for the grade analysis, students' grades on business and policy courses, and business and policy work placements are correlated, to measure the relationship between theory and practice for both business and policy courses and their corresponding work placements. We expect business theory grades to correlate positively with business work placement and policy theory grades to correlate positively with policy work placements. Lastly, assuming an ideal situation, we expect the business theory grades to correlate most positively and highly with business placements and the policy theory grades to correlate most positively and highly with the policy placements.

IV. Methodology

For investigating student background, data of all students who followed the SBP-track between the academic years 2003/2004-2019/2020 were employed. For investigating study records, data were extracted from the archive of the SBP-track, that contained study records of all SBP-students finishing a work placement between the academic years 2003/2004 - 2016/2017 (for these years we had complete records to our disposal). Study records included SBP-students' reports and grades, which served as units of analysis. For the grading analysis, only grade data between the academic years 2015/2016-2019/2020 were used, as grading practices were revised after 2014/2015. Before 2015/2016, students received a combined grade for business and policy, making it unable to measure the relationship between a business or policy course grade with a business or policy work placement.

IV.1. Analysis of advice reports

A directed content analysis (DCA) was carried out to analyse the science advice reports of the SBP-students. This implies that a predominant deductive approach was applied in analysing the data while allowing for an inductive

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approach. Before the coding process, student names were replaced with student numbers to guarantee confidentiality. The variables being examined, as well as their categories, were predefined to the furthest extent possible before analysis. However, whenever data were associated with a certain variable but did not fit into a predefined coding category, the data were stored and in a later stadium coded inductively. An important advantage of DCA over a purely inductive thematic analysis is that DCA contributes more explicitly to theory formation. DCA allows researchers to concentrate on parallels or deviations with existing theory and are less likely to 'drown' in the details of the data: DCA brings focus.[49,50]

All topics coding categories were categorical or binary in nature and were – before, during and after analysis - checked for mutually exclusiveness. The reports were examined by coders on the presence of coding categories, which were recognized by the inclusion of specific words or phrases (e.g., 'Biology' for 'Student background), and theoretically formulated themes (e.g., 'Exploring the market' for 'Position in stages of business cycle') in the reports. For the first type of coding, coders exclusively relied on the presence of specific words/ phrases. For the latter type of coding, interpretation was needed to translate the data into a coding category and in some cases to inductively add new categories.

While the authors of the paper acknowledge that predetermined coding categories can bias analysis in favour of certain theories[51] they are confident that in the context of this study, the initial coding will not affect the recognition of important content due to the nature of the data and the theoretical framework employed. That is, the theoretically formulated themes and coding categories match the theoretical framework students had to employ in their science advice reports.

IV.2. Procedure

All coding topics and their categories were collected in a codebook, which served as a coding guide for the coders. Table 2 shows an example of the manner in which topics and categories were explicated in the codebook

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[49] AnneLoes van Staa and Kirsten de Vries, "Directed content analysis: een meer deductieve dan inductieve aanpak bij kwalitatieve analyse." *KWALON* 19, no 3 (May 2016): 46-50.

[50] Hsiu-Fang Hsieh and Sarah Shannon, "Three Approaches to Qualitative Content Analysis." *Qualitative health research* 15, no. 9 (December 2005): 1281-83, https://doi.org/10.1177/1049732305276687.

[51] Hsieh and Shannon, "Three Approaches to Qualitative Content Analysis," 1283.

for two variables: 'Work placement size' and 'Position in stages of the policy cycle'. The codebook included for each variable its coding categories, how-to-code coding explanations, as well as references to articles and/or documents from which the categories/explanations were extracted. For the full codebook, the reader is referred to Appendix A.

Three student-assistants, which were SBP-students, coded the data together under the supervision of the authors of this paper. It was a deliberate choice to appoint SBP-students as coders. Because the coders had theoretical knowledge about the theories involved in this study, less intensive coder training was necessary to become an adequate coder. In addition, having SBP-students as coders may have improved the coding quality as it is reasonable to assume that having knowledge about the program makes coding more straightforward, evident and reliable in the context of this study. Because coding topics and corresponding categories were primarily predetermined, potential coder bias resulting from being familiar with SBP was minimalized. Still, it is recognized that the coders were students with a science background who were not familiar with quantitative nor qualitative coding practices, which are often carried out by researchers from social sciences. Therefore, before, during and after coding a research-assistant with experience in coding was available for additional training and consultation.

Table 2

Codebook example for work placement size, and position in policy cycle

Variable	Code	Explanation
Work placement size	1,2,3,4.	This variable needs to be scored for all science advice reports. The size of the organisation is based on the number of *all* employees on payroll at the organisation. 1 = micro-sized = 1-9 2 = small-sized = 10-49 3 = medium-sized = 50-249 4 = large-sized > 250 The size of the organisation should be available in the science advice report. If the organisation size is not mentioned in the science advice report, contact one of the supervisors. They will retrieve the information on the number of employees and pass it on to you. The categories are based on the European Commission's Recommendation on classifying organisation sizes.

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Variable	Code	Explanation
Position in stages of the policy cycle	1,2,3,4,5,6. & 0, 1	This variable needs to be scored *only* for science advice reports that were written in the context of a policy work placement. There are six categories in the policy cycle. These categories are referred to as *position in stages* in the policy cycle. Within a policy work placement science advice report, multiple stages can be mentioned and treated as such by the student. 1 = Setting the agenda 2 = Problem analysis 3 = Design 4 = Stipulation 5 = Execution 6 = Evaluation Decide for each chain whether or not it is: a) mentioned explicitly, *and;* b) explained correctly by the student. 0 = no, 1 = yes. Only score 1 when both condition a) and b) are met. The policy cycle and its chains are based on Howard[52], Hoogerwerf & Herweijer[53], and Dunn[54].

Whenever the coders disagreed about which coding categories the data should be assigned to, or were in doubt whether certain coding categories fitted the data correctly, one of the supervisors was consulted. Based on deliberation between this supervisor and two coders, coding categories were assigned to data or data were coded inductively. The coders coded the data during ongoing collaboration and calibration.

V. Results

V.1. Student population and background

In this paragraph, the student populations within the faculty and SBP-students' backgrounds are outlined to document the interest in the track over

[52] Commission of the European Communities, "Commission Recommendation of 6 May 2003 concerning the definition of micro, small and Medium-sized enterprises, 36–41. Howard, "The policy cycle", 3-13.

[53] Hoogerwerf and Herweijer, *Overheidsbeleid*.

[54] Dunn, *Public policy analysis*.

the subsequent academic years, as well as the choice for the track, differentiated for the student's prior discipline. Because of the varying science backgrounds of the SBP-students we related the choice for the SBP-track to the total cohort numbers of students in the various disciplines.

In total, 444 students completed the SBP-track, starting their work placements between 2003/2004 and 2019/2020 (Figure 7). Subscription numbers have increased over time. In 2017/2018 and 2018/2019 the course program was fully enrolled (a capacity of 65 places). Some students signed in for only a single course in 2017/2018 and 2018/2019, resulting in a lower number (i.e., <65) of students completing the SBP-track. In the academic year 2019/2020, all places in the SBP-track were completely filled. Currently, there is a waiting list to enrol in the SBP-track.

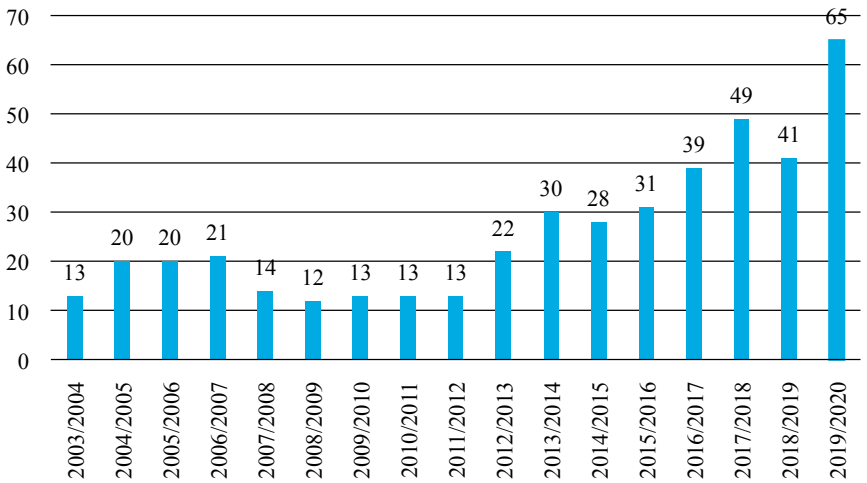

Figure 7

Number of SBP-students per academic year, 2003/2004-2019/2020, N_{total}=444

The scientific backgrounds of the students vary. All SBP-students are science students enrolled at the faculty of Science and Engineering. Engineering students are excluded from the SBP-track. The studies that are (or have been) compatible with the SBP-track are Chemistry, Physics, Computing Science, Mathematics, Molecular Biology & Biotechnology, Medical Pharmaceutical Sciences, Marine Biology/Ecology & Evolution, Biology, Biomedical Sciences, Energy & Environmental sciences (for the

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latter, enrolment is possible since 2019) and Behavioural & Cognitive Neurosciences (but not within a specific research master). Results show that the largest fraction of SBP-students has a science background in Biomedical Sciences and Biology (Figure 8).

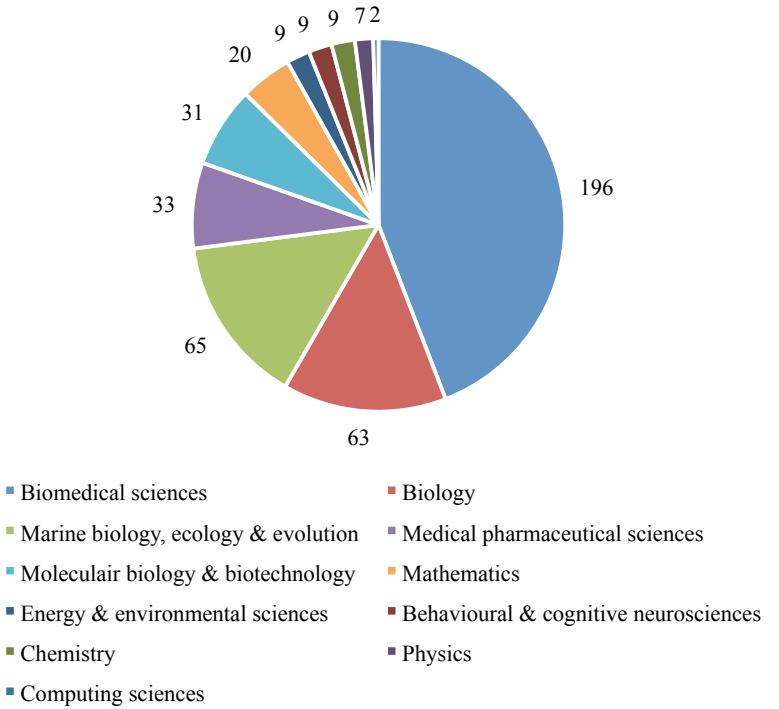

Figure 8

SBP-students' disciplinary background 2003/2004-2019/2020, N_{total}=444

The number of students in the studies that form the background of SBP-students differ in size. Science students choosing SBP make up between 2-11% of the entire science student population at the University of Groningen between 2003/2004-2019/2020. The remainder of science students choose a research-, or educational-oriented master's track (89-98%).

Figure 9 shows for each disciplinary background the percentage of students choosing SBP after their first master's year. Physics students and Computing Science students only occasionally choose SBP. Looking at the

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relative numbers compared to the total amount of students in a track, Biology, Biomedical Science students and Marine Biology students choose SBP most often. Physics is more oriented on fundamental research then other FSE programs and Computing Science is mainly focused on programming. These students may not associate their future career immediately with business or policy. As such, SBP may seem a less logical choice for those students at first sight. Conversely, Biology, Biomedical Sciences and Marine Biology are fields more oriented on knowledge appliance in society. As such, SBP might be more popular among those studying in these fields.

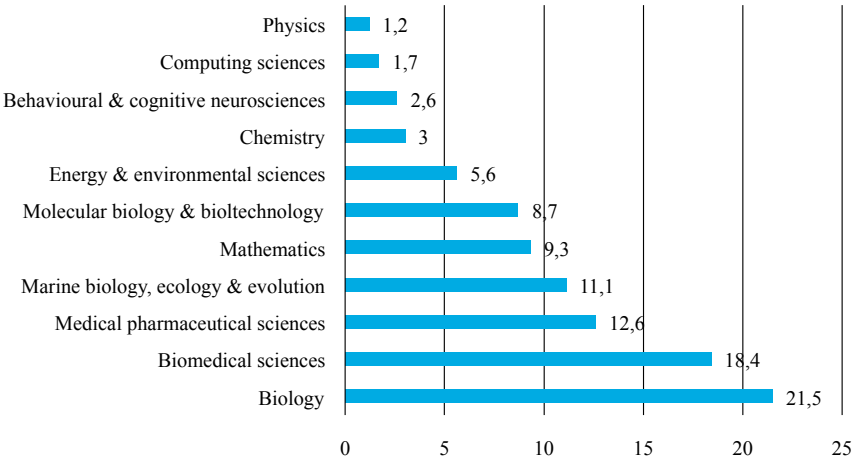

Figure 9

Percentage of the total disciplinary cohort of science students choosing SBP per background, 2003/2004-2019/2020

V.2. Work placement characteristics

Figure 10 A-D shows several work placement characteristics, including type, size, sector and location. Figure 10A shows that more than half of the 289 work placements analysed took place in a commercial setting: business placements make up 57% of all work placements. Policy work placements are the most common work placement after business placements: 38% of all students choose a work placement in a policy context. A minority of the students, 5%, have a NGO work placement.

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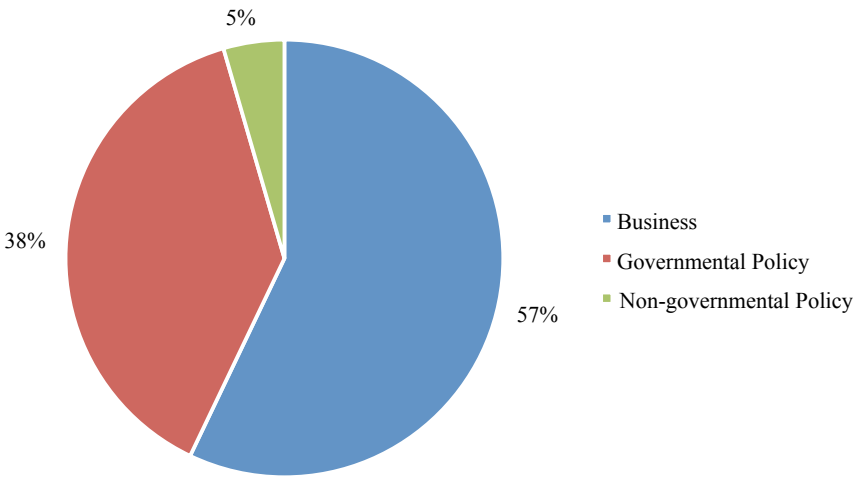
About half of the work placements take place in organisations with 250 employees or more (Figure 10B). The other half takes place in small-, to medium-sized organisations, or SME[55], where the number of employees of 14,2% of the placements are in micro (1-9 employees), 21.1 % in small (10-49 employees) and 13.5% in medium (49-249 employees) size enterprises or organisations.

The sector work placements most often take place in are healthcare & pharmacy and agriculture & environment (Figure 10C).

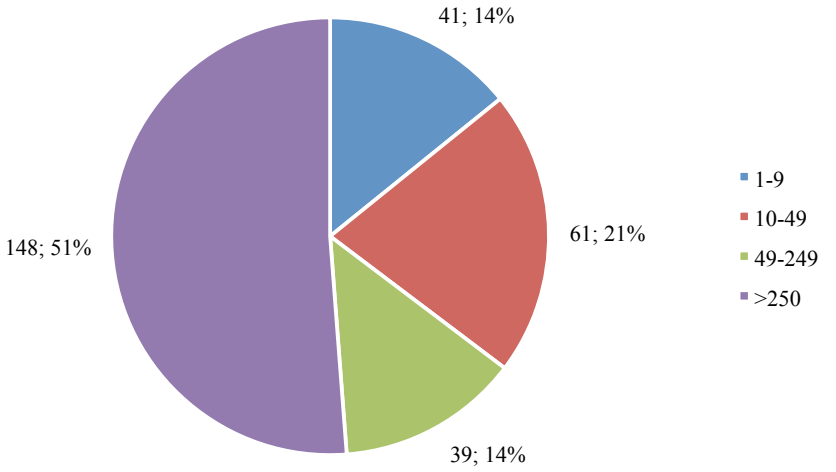
Focusing on geography, more than half of the SBP-students (57.4%) stay in the North of the Netherlands (Provinces of Groningen, Friesland and Drenthe). About 5% of the students choose a work placement in a foreign country (Figure 10D).

A: Work placement type

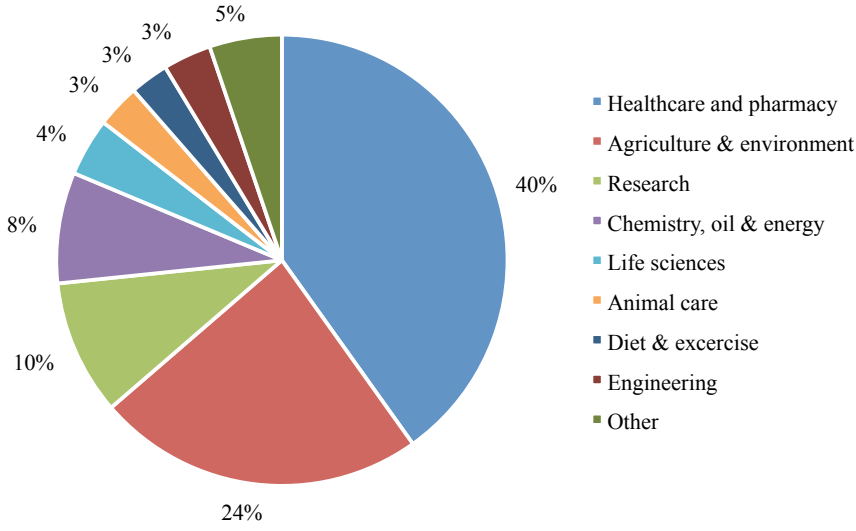


[55] Commission of the European Communities, "Commission Recommendation of 6 May 2003 concerning the definition of micro, small and Medium-sized enterprises," *Official Journal L* 124 (May 2003): 36–41, http://data.europa.eu/eli/reco/2003/361/oj.

B: Work placement size



C: Work placement sector



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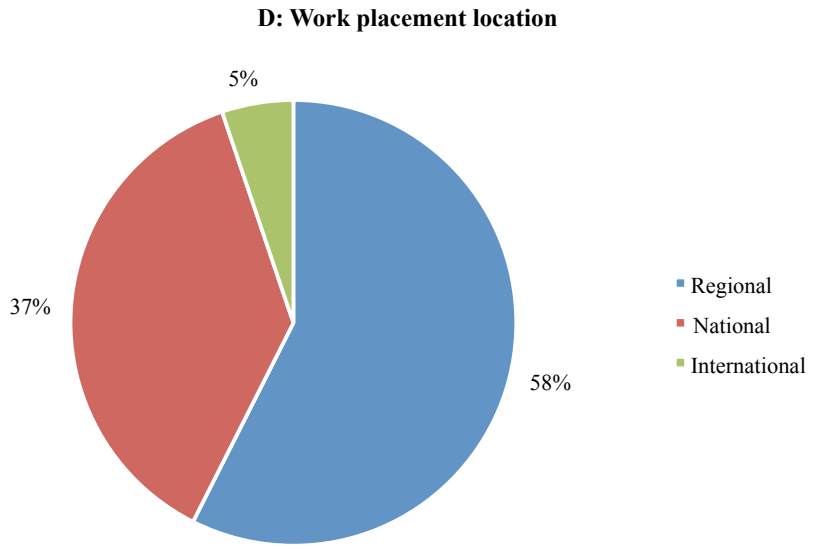

Figure 10A-D
Work placement characteristics, 2003/2004-2016/2017, N_{total}=289

V.3. Type of work placement assignment & position in stage of cycles

The different types of assignments extracted from the content analysis of the executive summary of the science advice reports are shown in Figure 11. The most frequent types of assignments were implementation, feasibility evaluation, product/policy evaluation and market research advice. Communication strategy, organisational structure and market demand advice were included in the reports least frequently. In total, 336 types of assignments were present in 289 reports, implying combined use of types of assignments.

Besides the type of assignment, the position in the stage of the advices also varied. When placed in the business innovation cycle (Figure 12) or policy cycle (Figure 13), we see that most work placements with a business assignment are in the stage of analysing technical feasibility or market exploration. The policy placements are most commonly in the problem analysis or design and formulation stage.

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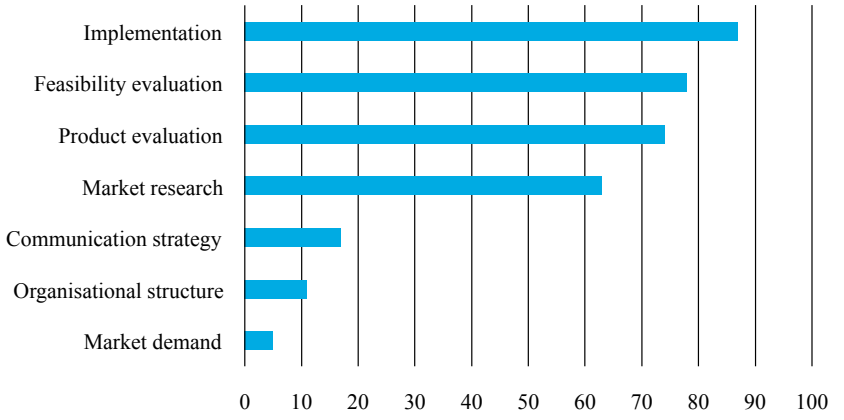

Figure 11

Type of work placement assignment, 2003/2004-2016/2017, $N_{assignments}$=336, $N_{students}$=289

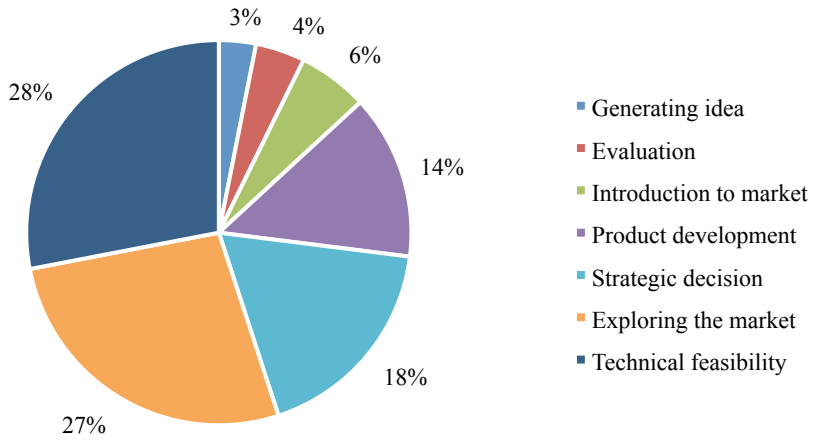

Figure 12

Position of stages in the business innovation cycle, 2003/2004-2016/2017, $N_{business\ students}$=165, $N_{business\ innovation\ cycle\ stages}$=289

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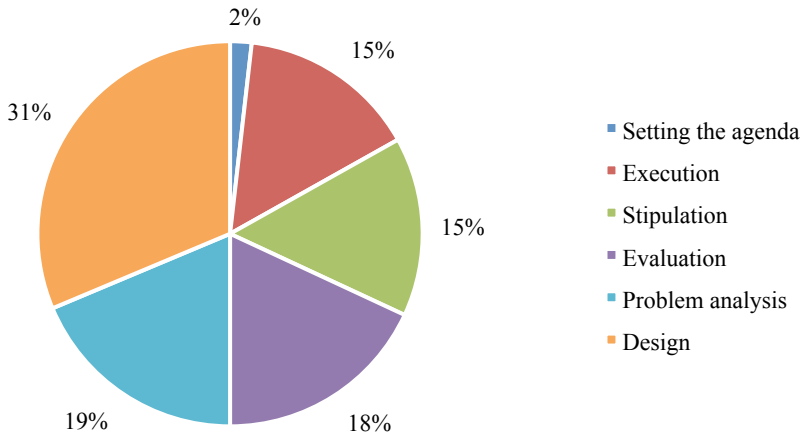

Figure 13

Position of stages in the policy cycle, 2003/2004-2016/2017, $N_{policy\ students}$=124, $N_{policy\ cycle\ stages}$=166

V.4. Source usage

In work placement reports between 2003/2004-2016/2017, 289 students cited 25140 literature references, which reflects an average of 87 per student. Besides (scientific) articles, students used other sources for information, for example collecting information by conducting expert interviews. It should be noted here explicitly that because SBP-students do not carry out their own conclusive scientific research during a work placement, they use external information sources only.

When external contacts explicitly had impact on the final result students had to report these sources in their advice report (e.g., an interview transcript added to an appendix). Figure 14 shows the number of external contacts used as information source. In total 1528 contacts were used, with an average of 5,3 per work placement. Most external contacts were used as information sources in work placements at NGO's, followed by policy placements, with the least input from external contacts at business placements.

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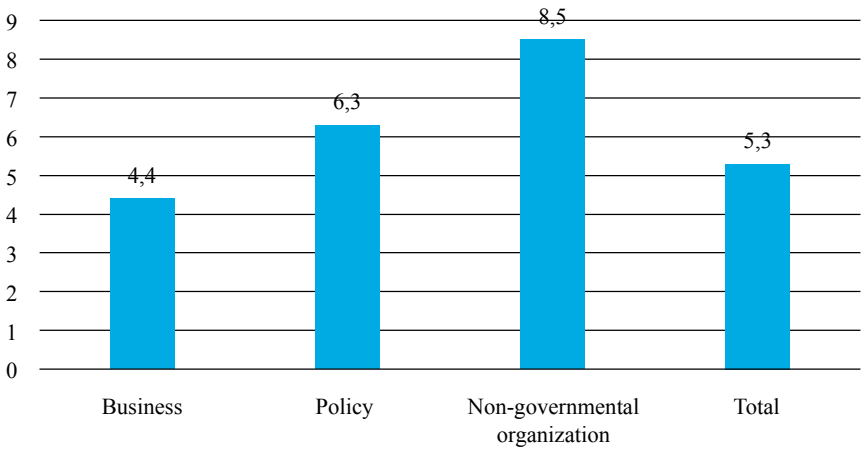

Figure 14

Means of references to external contacts per work placement type, 2003/2004-2016/2017, $N_{students}$=289

V.5. Business and Policy tools

Business and policy tools that were employed in work placements were scored. The scored models were those explicitly taught in the lectures during the preceding courses (see for example Figure 7). In the policy related placements (Number of students=124) the most frequently used tools are stakeholder analysis (N=50), the SWOT analysis (N=17) mapping of the organisation culture (N=15), and internal analysis (N=15). In the business placements, a more differentiated use of models could be observed. Table 3 shows the absolute frequency of tools used by the students in a business work placement.

Table 3

Frequency of tools used in business work placements, 2003/2004-2016/2017, $N_{students}$=165

Tool	Frequency business placements
SWOT analysis	69
Internal analysis (general)	58
Porter's 5 forces	52

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Tool	Frequency business placements
Organisation structure	39
PESTEL	33
External analysis (general)	30
Stakeholders/actors	28
7S model	27
MCCBA / cost-benefit	19
Ansoff matrix	3
Business model canvas	2
Goal-resource analysis	2
BCG-matrix	2
Technology adoption lifecycle	1
Market share matrix	1
Customer buying cycle	1
Product life cycle	1
Total	**368**

V.6. Tools in loop model

In Table 4, the relative number of students who used at least one model in the loop is shown. The loops that are most often covered are loop 3 (61,2%) and 2 (51,5%). Loop 5 has not been scored because the SBP-track had not fully standardized the use of tools denoting implementation in earlier years.

Table 4

Relative frequency of tools used in business placements per loop in the societal domain of the loop model, 2003/2004-2016/2017, $N_{students}$=165

Loops societal domain	Tools	Percentage of students using at least one tool
Problem analysis & target Group	causal/fieldmodel, stakeholders/actors, Goal-resource analysis, Technology adoption lifecycle, customer buying cycle, product life cycle	27.9%

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Loops societal domain	Tools	Percentage of students using at least one tool
External analysis	PESTEL, Porter's 5 forces, External analysis (general)	51.5%
Resource analysis & Internal capacity	7S, Internal, BCG-matrix, organisation structure	61.2%
Feasibility & Strategy	SWOT, business model canvas, MCCBA/ cost-benefit, ansoff matrix, market share matrix	48.5%
Acceptability & Implementation	n.a.	–

V.7. Grades

Table 5 shows the correlations, means and standard deviations for final exams and work placement grades (1-10 scale) of all SBP-students. All grades are positively and significantly correlated with each other. Business and policy exam grades (theory) are more strongly related than work placements grades to either business or policy exam grades. The mean grades are all above average and are scored on a 1-10 scale (pass at 5,5).

Table 6 shows the correlations, means and standard deviations for grades of SBP-students with a business work placement. All grades are positively and significantly correlated. The business work placements grades are more strongly and positively related to business grades than business work placements grades are related to policy grades.

Table 7 shows the correlations, means and standard deviations for grades of SBP-students with a policy work placement. All grades are positively and significantly correlated. The policy work placements grades are more strongly and positively related to policy grades than policy work placements grades are related to business grades. Policy work placements grades are more strongly related to policy grades than business work placements grades are related to business grades.

While policy exam grades seem lower than the business exam grades, and both the business and policy exam grades seem lower than the work placement grades, a multivariate ANOVA showed that there are no significant differences between business theory, policy theory and work placement grades.

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Table 5

Descriptive statistics: correlation, means and standard deviations of student grades of all placements, 2015/2016-2019/2020, $N_{students}$=188

All work placements	Grade Theory Business	Grade Theory Policy	M Total	SD
Grade work placement	.299** (p=.000)	.355** (p=.000)	7.60	.70
Grade Theory Business	–	.542** (p=.000)	7.30	.93
Grade Theory Policy		–	6.91	1.00

* p=<.05; **p=<.001.

Table 6

Descriptive statistics: correlation, means and standard deviations of student grades of all business placements, 2015-2019, $N_{students}$=111

Work placement = Business	Grade Theory Business	Grade Theory Policy	M Business	SD
Grade work placement	.326** (p=.001)	.299** (p=.001)	7.59	.76
Grade Theory Business	–	.538** (p=.000)	7.25	.93
Grade Theory Policy		–	6.85	.88

* p=<.05; **p=<.001.

Table 7

Descriptive statistics: correlation, means and standard deviations of student grades of all policy placements, 2015-2019, $N_{students}$=77

Work placement = Policy	Grade Theory Business	Grade Theory Policy	M Policy	SD
Grade work placement	.251* (p=.030)	.462** (p=.000)	7.62	.62
Grade Theory Business	–	.555** (p=.000)	7.36	.92
Grade Theory Policy		–	6.99	1.15

* p=<.05; **p=<.001.

VI. Retrospect, conclusion & discussion

In this paper, we described a case study of an academic (university level 7) work-based learning (WBL) master's program. This WBL-program, the Science, Business and Policy (SBP) track, is offered at a Dutch research

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university at the faculty of science and engineering. The track is developed to prepare science students for a science career in business or policy, and is a direct response to the Bologna Process (i.e., a reform of European education), serving as an alternative for a traditional research master's track. The SBP-track offers societal differentiation by including a work placement at a business or policy organisation and a focus on science advising, as opposed to a research track, that mainly includes theoretical courses and has a strong research focus.

A major aim of this paper was to explain the build-up of, and the reasoning behind this WBL-program, including the explanation of the theoretical framework used to develop the SBP-track, as well as laying out the learning goals and tools derived from these frameworks. In addition, alumni records of the SBP-track from 2003-2019 were analysed, on student population and background, work placement characteristics and assignments, source and tools usage and grades for theoretical courses and work placements. The results of this case study indicate that several factors can be seen as relevant for a successful elaboration of an academic WBL-program.

VI.1. Design and curriculum

In our view, six important factors can be distinguished that put emphasis on the success of SBP as a WBL example, due to its design of the curriculum. First, the SBP-track was specifically designed to function as a WBL-program, created by academics for academics, as a formal reaction to the Bologna process. This makes that the program has an explicit focus on narrowing the gap between the scientific and the professional field without compromising on the academic level and constantly monitoring this.

Second, the SBP-track is offered completely within the curriculum of a research university (level 7) science masters' and students receive the full amount of ECTS (120 ECTS) necessary to graduate. That is, the SBP-track fits in the typical two-year structure of science master's programs in the Netherlands. The SBP-track's courses (20 ECTS) and work placement (40 ECTS) are offered completely and exclusively within the curriculum. This creates the possibility for students to focus and gain substantial theoretical and scientific knowledge based on specialized disciplinary research in a first master's year (60 ECTS) and a focus on experience outside academia (60 ECTS) in a second (SBP) master's year. The efficiency of the work placements is enhanced by staff specifically devoted to the SBP-track, who support students in arranging and preparing work placements, reviewing during work placements, and evaluating after work placements.

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Third, strict starting requirements, including a sufficient academic level and intensive disciplinary knowledge at entrée (i.e., a pass on a first master's year disciplinary thesis) contributes to the quality of the SBP-track. On the same note, students have to pass their business and policy courses before they are allowed to start the work placement. As a result, students normally do not fail their work placements (spare exceptions due to personal circumstances). Hence, a basis for an academic performance is given, since a previously completed master's thesis in research and a pass for the business and policy courses are required to start the work placement.

Fourth, the project approach that forms the core of the SBP-track facilitates students to fully engage in high-quality work-based learning, for instance by studying real-world topics in academic courses and practicing real-world topics through solving existing (i.e., real) problems during the work placements. To make students connect with prior academic knowledge, models that are similar to models already familiar to students (e.g., the empirical cycle of science) are used to approach policy and business (i.e., the loop model, the business innovation cycle and the policy cycle) during the SBP master's year. These models are specifically tailored to serve the practical goals of the SBP-track, along with supporting the academic level of SBP. That is, these models, based on academic literature, establish a broad theoretical framework for SBP-students.

Fifth, while the SBP-track does include theoretical courses in its curriculum, its main focus lies on the integration and implementation of knowledge. The SBP-track is designed to lead to integration at three levels: between different science disciplines, between science and business/science and policy, and academia and the professional work field ("town and gown"). This fulfils the criteria of WBL that theory is necessary, yet the main component should be learning in real life practice. The threefold integration within SBP seems important to match the requirements of the present-day career that education is interdisciplinary, practical applicable and competence-based. That is, there is a need to match the criteria of an academic educational institute with the ability to offer education that can be tailored to individual students, enhances critical thinking and meets the academic level.[56] The SBP-track meets this academic level, and combines it with a systematic integration of complex information and gaining experience in the work field.

Sixth, the strength of the SBP-track originates in the appliance of learning objectives that are specifically formulated to match the WBL educational method in academia. These learning objectives are developed to

[56] Lester and Costley, "Work-based learning at higher education level," 570-572.

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let students achieve a common and generic academic final level. Within the university, the learning objectives have often been evaluated in recent years, with all parties involved - including business and policy experts. Perhaps surprising, in the course of 15 years teaching SBP there has never been risen a need for adjustment. The learning goals seem to still fit the requirements of academic WBL-practice.

Hence, based on these six factors, the SBP-track - as well as other properly-designed academic WBL-programs - can thrive well within the Bologna Declaration. A WBL-program is in this sense able to narrow the gap between academia and the professional work field without compromising on academic level.

VI.2. Alumni study records

SBP-students' study records were explored for purposes of determining possible factors for quality and success of WBL-programs, as well as for retaining more comparable information on academic WBL-programs. First, exploration of the student population throughout the years, including student backgrounds showed that the SBP-track attracts a growing number of students, many of them having a background in biomedical sciences and biology. In total, 444 students followed the full track between 2003/2004-2019/2020. An increasing number of students is opting to spend their final master's year on SBP. From 2016/2017 to 2019/2020, the SBP-track's capacity has been fully booked. The actual demand is difficult to extract from the growth numbers since the program has a restricted intake capacity due to practical limitations. Still, it is becoming an increasingly common practice that potential new students are waitlisted for at least one year.

As the founders of the SBP-track intended, the results show that the SBP-student population is multidisciplinary. The largest cohorts are from biology and biomedical sciences. This is representative for the whole faculty, as biology and biomedical sciences form the largest science master's programs. In our personal experience the awareness of the existence of the SBP-track varied - and may still vary - between the disciplinary programs. In addition, it has to be mentioned that the amount of promotion made for the SBP-track between staff members from different disciplines varied - and may still vary - as well. Still, the enhanced interest of students from different disciplines within science in this societal WBL-program is noticeable. Growing student numbers from increasingly different disciplines may be an indication for the quality and success of the SBP-track.

Second, several characteristics of student's work placements were analysed, including type, size, location and sector of the work placement. These characteristics show quite a diversity of work placement characteristics, but also some trends. Based on work placement type and size, there are indications that smaller as well as larger organisations in the corporate world can benefit from the interest of SBP-students. For instance, more than half of SBP-students choose a business type work placement, and more than half choose a work placement organisation with more than 250 employees.

In addition, over half of all work placements take place in the North of the Netherlands, where the University of Groningen is situated. This finding seems somewhat remarkable because in the northern region of the Netherlands there are less large employers compared to the rest of the Netherlands. However, cities in Northern Netherlands, e.g. Groningen, actively profile the life science sector during national and international fairs, in order to attract investments and business in this sector.[57] This might partly explain why students tend to stay in the North of the Netherlands: life sciences work placements are available, mainly in smaller and medium sized enterprises. This could also be a consequence of individual preferences since students arrange their own work placements. How this may be, the region profits from the availability of students of the SBP-track. As such, there are indications that SBP functions an economic impulse to the region. Work placements abroad initially have been exceptional but are becoming increasingly common. This may be attributed to the enrolment of more foreign students in the University of Groningen and the fact that the SBP-program recently became available in English (from 2016 onwards). Lastly, while work placement sectors are diverse, work placements in the sectors of healthcare & pharmacy and agriculture & environment are most popular. This coincides with expectations, given the science background of SBP-students – mostly in biomedical sciences and biology.

Third, work placement advice reports were screened, focusing on types of advice given, position in stages of business and policy cycle, business and policy tools applied, position of tools in phases of the loop model, and source usage in the report. As expected, there was a diversity in the stages in business and policy cycles applied in the advices. This underlines that various components of the business and policy cycle can be used effectively within advice reports, for different types of advice. In addition, multiple business and policy tools are used, as well as tools offered in several phases

[57] "*Gemeenterekening 2018"*, Gemeente Groningen, accessed September 29, 2020, https://gemeente.groningen.nl/sites/default/files/Gemeenterekening-2018-Groningen.pdf.

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of the loop model. These results suggest that a tailored, yet broad theoretical framework for SBP-students supported the quality of their advice report. That is, in order to make individual work placement assignments successful for this master's track, there should be room for a variety of tools that can be used interdisciplinary, yet still fitting within the framework of science, business and policy. Besides the diversity of tools found in the advice reports, the alignment in, and the sufficiency of the offered business and policy tools strengthen this finding.

Furthermore, students integrated a large number of scientific references and external contacts in their advice reports. The data suggest that students carried out a thorough literature search for their advice reports. In addition, students' references to external contacts showed the expansion of their professional network with contacts who contributed to their science advice report. Please note that the real expansion of student's professional network might be higher, since only the explicitly mentioned sources have been recorded.

Fourth, work placement grades, and grades of business and policy exams were compared. It should be noted that there were slight changes in didactics due to the continuing development of the SBP-track. Although the learning objectives remained the same throughout the years, assessment methods (such as assessment rubrics) changed slightly. The results can therefore only be interpreted as explorative, and conclusions that are drawn are formulated with caution.

Grades of all SBP-components varied from sufficient to good. As students choose the topic of their work placement themselves, it was expected that work placement grades were higher than grades for compulsory courses. While differences were not significant, work placement grades tend to be higher than grades for theoretical courses. In addition, business theory grades seem to be higher than the policy theory grades. A possible explanation could be the information density and the nature of business literature, resembling more closely what students are used to during their prior science education. For the policy course, students had to read and disentangle policy documents, often ambiguous and novel. Thus, the policy course may be more difficult than the business course for science students. It could also be due to other (intrinsic) difficulties of the discipline or challenges associated with the way courses are organized.

Business and policy theory grades correlated positively, as well as the work placement grades did with both business and policy theory grades. The correlation values are moderately positive and only grade theory business with grade theory policy (.542 combined, .538 business placements, .555 policy placements) exhibit a considerable positive correlation. This is quite

understandable as these are both course-based. Table 6 shows a small difference (.326 vs. .299) that seems to suggest that grade work placement for business placements is almost similarly correlated to both grade theory business and policy while Table 7 on all policy placements have a bigger gap (.251 vs. 462). While this should be kept in mind, still, correlations between work placements and matching theory grades were stronger than unmatching theory grades (i.e., business work placements with business theory & policy work placements with policy theory). As students choose the type of work placement that suits their expertise best, it is not unlikely that grades on theory courses that are more in line with their expected future career (i.e., in the area they carry out their work placement) correlate stronger. These results give indications that it is also possible to evaluate students' academic level by grading their work placement reports, as opposed to evaluating students only based on results on theoretical exams. That is, student quality in the area of business or policy is not only reflected by the results on their business or policy courses, but also by their work placement grades. Based on our results, this is especially true for the policy work placements.

Looking at the SBP-track, it can be concluded that the societal interpretation of the Bologna process has been implemented successfully, by closing the theory-practice gap with academic learning and furthering professional experience using a WBL-approach. This case study showed that a heterogenic population of science students (i.e., students of different disciplines) can address a heterogenic population of problems for business and policy organisations with a very diverse character, sector, size and region, by using a variety of tools and sources.

This diversity can form an educational challenge, since there is no one-size fits all approach possible. However, a WBL-approach, in this case translated to the SBP-track, seems to have the potential to include all the described variety. As such, academic WBL-programs could be an answer to the call from the work floor, but also from students to realize a better connection between achieving academic level and gaining hands-on-experience. In this way, one academic degree does not only comprise of science and societal aspects but is also earned by practical projects and actions that are needed to get there.

VI.3. Future questions

Besides introducing the theoretical framework applied to design the SBP-track, this article aimed to share possible success factors for academic

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WBL-programs. Simultaneously, we provided some insights into the SBP-track's student population and their study records. We invite colleagues to share their methods and approaches used to develop academic WBL-programs. Being able to compare different case studies on fulltime bachelor's and master's level WBL-programs has the potential to form a more cohesive and extensive theoretical framework on quality assurance of academic WBL-programs.

In order to improve education, Lester et al.[58] stress that more in-depth qualitative research based on real programs could also be employed to explore the extent to which different pedagogies and curricular structures support effective learning and develop capability and professionalism in different fields and contexts. This area of research would need to have a longitudinal element to look beyond end-of-program outcomes to the effect on careers and, where relevant, further study. It can also be useful to explore the long-term effects of WBL versus traditional programs on (prior) students. For that reason, we started to investigate SBP-alumni experiences with the WBL-program, and their careers after graduating, in relation to experiences from alumni who graduated in a research-oriented profile.

Furthermore, research about conditions that are needed for successfully implementing a WBL-program within academia can be examined. What does implementing a WBL-program mean for the organisation of education and the qualities needed of the teachers or instructors? An evaluative study is currently conducted with staff of the faculty of Science and Engineering at the University of Groningen to assess professors' perceptions related to the SBP-track.

Finally, it is also important to extend the analysis of the societal impact of WBL. Therefore, we are investigating experiences of the providers of the work placements. Does WBL really help in preparing students for their career and are students able to make a difference within business and policy organisations? Whether the desired societal impact is reached, is currently being verified by carrying out interviews with SBP-supervisors from the societal institutions involved with the SBP-student's work placements.

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Covid-19 Section: Call for papers

Call for papers

Special Section on Covid-19: Experiences, impact, and implications for Higher Education

The COVID-19 pandemic has created challenges throughout the world at all levels of society, with no exception. Higher education has been impacted strongly, initially with an imposed shift to online modes of delivery, and, subsequently, with a prolonged transition which seems to be questioning the temporary nature of this shift. The emergency remote response has benefitted from effort, time and goodwill displayed by staff and students, as new roles and responsibilities have had to be accommodated in situations which strongly resembled crisis management. Initially, a level of leniency and tolerance was exhibited by all stakeholders as HEIs were finding ways of coming to terms with stringent restrictions while aiming to safeguard the educational experience, overall, and teaching, learning and assessment standards, more specifically. The transition period, however, saw an increase in quality expectations regarding online delivery, with staff and students recognizing that it could no longer be sufficient to replicate face-to-face activities for the online environment and more investment would be needed to attain an acceptable level of quality. As such leadership structures in higher education institutions are now prompted to decide and communicate clearly what the post-pandemic position is likely to be, so that efforts can be relevantly targeted. External stakeholders, such as governments, industry representatives and the public at large, are also strongly involved in this debate, as the likelihood of whole higher education sectors to exhibit significant change is foreseeably high.

The Tuning Journal for Higher Education focusses on two key aims: (1) to provide a platform for constructive debate amongst stakeholders concerning the promotion of excellence in all aspects of Higher Education; and (2) to enable the dissemination and critical reflection of good educational practises, innovation and research. It is therefore highly appropriate that, one year on from the pandemic outbreak, at a time when we can take stock of the experiences and derive lessons learned to inform strategic post-pandemic decisions, the Tuning Journal for Higher Education is proposing the inclusion of a Special Section on Covid-19 higher education experiences and their impact for the future. The intention is to offer a platform for exchange of experiences within higher education which can support the current debate amongst stakeholders and encourage solutions for the "New Normal". Though pandemic realities have been most challenging, it is our belief that the momentum for development and growth should not be lost. Options which would have rarely been considered viable in pre-pandemic higher education are becoming increasingly appealing to a variety of stakeholders. The world of higher education is now preoccupied with the major question of what will each institution, each national sector, each regional structure take forward as they craft their post-pandemic profiles.

The Special Section aims to foster international academic reflection, detailed analysis and on-going dialogue by bringing together diverse opinions, multiple voices

and various perspectives. We invite higher education institutions (senior management, staff and students), quality assurance agencies, ministerial bodies, industry representatives and other stakeholders to propose contributions, as research articles, case studies or policy papers, on the following topics, specifically related to the pandemic:

- leadership and strategic decision-making with a view to the future
- analysis of changing institutional/organisational roles and responsibilities
- higher education crisis management and reflection on solutions implemented
- experiences of staff, students, other stakeholders and lessons learned
- internationalisation and mobility challenges
- approaches to quality and quality assurance
- shift to online teaching, learning and assessments and impact on learning outcomes
- adjustments to programme design and curriculum delivery both during HE and for future students (including as related to practice-based activities)
- staff and student performance within the digital/virtual environment, including aspects of capacity building, continuous professional development, upskilling, and reskilling
- teaching methodologies, materials development, assessment options appropriate in emergency remote response and/or the transition period, including aspects of ethics
- infrastructural changes for modern technologies in education
- emphasis and development of support services, for students and staff
- impact on research, development and other creative activities, including service to society
- considerations of temporary versus permanent solutions and implications for future directions

Key dates for authors:

- For the November 2021 Issue: **1 July 2021** – submission received
- For the May 2022 Issue: **1 February 2022** – submission received

Guidelines for authors can be found at: https://tuningjournal.org/about/submissions

Please contact the TJHE Editor, Professor Mary Gobbi (mary.gobbi@deusto.es), or the Covid-19 Section Editor, Professor Anca Greere (anca.greere@softwaredesign.ro), for any questions or clarifications.

Editor's Acknowledgments

Editor's Acknowledgments

Once again, the editors offer very sincere and genuine thanks to all who have helped produce this edition of the Journal.

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Mary Gobbi
May 2021

Corrigendum

Corrigendum

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Correction to:

Şeyma Şahin and Abdurrahman Kılıç, "Evaluation of the teaching practice course carried out with the Lesson Study Model," *Tuning Journal for Higher Education* 8, no. 1 (2020): 99-127, https://doi.org/10.18543/tjhe-8(1)-2020pp99-127 (first published online on 17th November 2020).

In the print edition of the above-mentioned article, there was a mistake in one cited source:

Footnote no. 39:
Tolgahan Ayantaş, "Lesson Study Practice in The Development of Professional Teaching Knowledge of Pre-Service Teachers of Social Studies" (Master diss., Pamukkale University, 2019).

Bibliography list entry:
Ayantaş, Tolgahan. "Lesson Study Practice in The Development of Professional Teaching Knowledge of Pre-Service Teachers of Social Studies." Master diss., Pamukkale University, 2019.

In both instances, Ankara University should have been written instead of Pamukkale University. The correct versions are as follows:

Footnote no. 39:
Tolgahan Ayantaş, "Lesson Study Practice in The Development of Professional Teaching Knowledge of Pre-Service Teachers of Social Studies" (Master diss., Ankara University, 2019).

Bibliography list entry:
Ayantaş, Tolgahan. "Lesson Study Practice in The Development of Professional Teaching Knowledge of Pre-Service Teachers of Social Studies." Master diss., Ankara University, 2019.

The corresponding online versions (PDF and HTML) were corrected on 18th December 2020.

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Guidelines for Authors

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General Information

Tuning Journal for Higher Education, TJHE, is a joint academic publication of the University of Deusto (Spain) and the University of Groningen (Netherlands). It is published by the University of Deusto on behalf of the two institutions. It appears twice a year, in May and November, in both digital and print formats. Its first Issue was published in November 2013.

It is an international peer-reviewed, open access journal publishing in English original research studies and reviews in all aspects of competence-based, student-centred, and outcome-oriented education reforms at university level across the globe.

The Journal publishes both thematic and unsolicited contributions on pressing educational needs of contemporary societies.

At any time of the year, the Journal welcomes submissions related to its scope and focus.

For at least the next two issues (November 2021 and May 2022), a call is here made for manuscripts specifically addressing the **experiences, impact, and implications of the Covid-19 pandemic for Higher Education**.

The submitted manuscript should not have been previously copyrighted or published in any form, including electronic media and databases, and must not be currently under consideration for publication elsewhere.

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TJHE
Ethical Guidelines for Publication

TJHE Ethical Guidelines for Publication

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Tuning Journal for Higher Education (TJHE), Tuning Journal in short, is an international journal publishing in English original research studies and reviews in all aspects of competence-based, student-centred, and outcome-oriented education reforms at university level across the globe. It is published by the University of Deusto's Publications department on behalf of the International Tuning Academy (Tuning Academy in short), a jointly managed project of the Universities of Deusto (Spain) and Groningen (The Netherlands). The Journal, essentially an open access, online and peer-reviewed publication, is committed to maintain the highest ethical standards. Hence, the involvement of any stakeholder in any function connected with TJHE, including acting as an editor, the reviewing of manuscripts, the management and production of the Journal and the authorship and submission of manuscripts implies acceptance of and adherence to **TJHE Ethical Guidelines for Publication**.

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1.1. The Editorial Board is appointed by the Tuning Academy in consultation with the Universities of Deusto and Groningen.

1.2. The Editorial Board is responsible for setting policy, appointing the Editor and Advisory Editors of the Journal.

1.3. The Editor is responsible for ensuring that publication policies set by the Editorial Board are carried out.

1.4. The Management Board is appointed by the Tuning Academy in consultation with the Universities of Deusto and Groningen.

1.5. The Managing Board is responsible for the commercial management of the Journal and appointing a Managing Editor.

1.6. The Managing Editor is responsible for ensuring that the commercial policies set by the Management Board are carried out.

1.7. Members of the Editorial or Management Boards or employees and, or members of the Tuning Academy should not intervene in or comment on editorial decisions on individual manuscripts.

2. Editors, Advisory Editors, and Guest Editors

2.1. *Editors* of the Journal and Specialist Volumes are expected to carry out editorial duties in a manner consonant with policies set by the Editorial Board.

2.2. The Editor has full responsibility, which he/she may delegate to an Advisory Editor, for editorial and technical decisions on Journal and specialist volume content.

2.3. *Editors* will give manuscripts unbiased consideration.

2.4. *Editors* should process manuscripts expeditiously.

2.5. The Editor has sole responsibility for acceptance or rejection of a manuscript. Manuscripts should have peer review, but the Editor may reject any manuscript for other causes (inappropriate for journal, clearly of poor quality, contents previously published elsewhere, etc.)

2.6. The Editor should not disclose information about submitted manuscripts except to reviewers, Advisory Editors, Editorial Board members, and staff at the University of Deusto's Publications department. Information about a manuscript may be shared after electronic publication (e.g., news releases or inclusion in a list of contents, etc.).

2.7. Manuscripts submitted by an *Editor* should be delegated to another Advisory Editor or Editorial Board member.

2.8. An *Editor* should not handle manuscripts for which there is a real or perceived conflict of interest. Examples include, but are not restricted to, past (within the last 5 years) or current collaboration, employer or employee, close friend, family relationship, institutional relationship, past or present graduate advisor or advisee, someone with whom the reviewer has had a past or on-going academic controversy, or situations where the *Editor* could stand to gain or lose economically or in any other way by publication or rejection of the manuscript. Editorial responsibility should be delegated to another Editor, Advisory Editor, or Editorial Board member.

2.9. An *Editor* must not use information, data, theories, or interpretations of submitted manuscript in her/his own work unless that manuscript is in press, published or the author has given permission to do so.

2.10. If an *Editor* is presented with convincing evidence that the main substance or conclusions of a publication is/are erroneous, he/she should facilitate publication of a report (e.g., correction, follow-up manuscript, or other appropriate means) pointing out the error and, if possible, correcting it. The report may be written by the person who discovered the error or by the original author. The original publication does not disappear from the published record.

3. Authors and Co-authors

3.1. Manuscripts should contain original, new results, data, ideas and/or interpretations not previously published or under consideration for publication elsewhere (including electronic media and databases).

3.2. Authors should be encouraged to avoid fragmentation of their work where practical, so that the submitted manuscript is as comprehensive and authoritative as possible.

3.3. Authors should inform the Editor of related manuscripts under consideration elsewhere and provide copies if requested.

3.4. Fabrication of data, results, selective reporting of data, theft of intellectual property of others, and plagiarism are unethical practices and unacceptable.

3.5. Information obtained privately (e.g., in conversation, correspondence, or discussion with third parties) should be avoided as it is not in the public domain and is thus unverifiable. If considered necessary, it should not be used or reported in a manuscript without explicit permission from the party with whom the information originated. Information obtained in the course of confidential services (e.g., refereeing manuscripts or grant applications) should be treated similarly.

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3.6. Manuscripts will contain proper citation of works by others, especially publications of the original hypotheses, ideas, and/or data upon which manuscript is based or addresses.

3.7. Authorship

a) Authorship should be limited to those who have made significant contributions to the concept, design, execution or interpretation of the work reported in a manuscript; others who have contributed should be acknowledged;

b) Author order should be agreed on by all authors as should any changes in authors and order that occur while the manuscript is under review or revision. Changes in authorship must be submitted to the Editor in writing and must be signed by all authors involved.

c) Authors and co-authors should review and ensure the accuracy and validity of results prior to submission; co-authors should have opportunity to review manuscript before submission.

3.8. Authors should reveal to the Editor any potential conflict of interest (e.g., a consulting or financial interest in a company) that might be affected by publication of the results contained in a manuscript. The authors should ensure that no contractual relations or proprietary considerations exist that would affect the publication of information in a submitted manuscript.

3.9. Authors are encouraged to disclose major funding sources (e.g., government agencies, private foundations, private industry, and universities) for reported research.

4. Reviewers

4.1. A reviewer should disclose real or perceived conflict of interests to the Editor before agreeing to write a review. Examples include, but are not restricted to, past (within the last 5 years) or current collaboration, close friend, employer or employee, family relationship, institutional relationship, past or present graduate advisor or advisee, someone with whom the reviewer has had a past or on-going scientific controversy, or situations where the reviewer could stand to gain or lose economically or in any other way by publication or rejection of the manuscript. The Editor will decide if the conflict is severe enough to prevent the reviewer from writing a fair, objective review.

4.2. A reviewer should decline to review a manuscript if she/he feels technically unqualified, if a timely review cannot be done, or if the manuscript is from a competitor with whom the reviewer has had an acrimonious professional relationship or a conflict of interest as defined above (section 4.1).

4.3. Reviewers should be encouraged, but not required, to sign reviews. The Editor will preserve anonymity of reviewers should a reviewer elect to remain anonymous.

4.4. Reviewers must treat the manuscript as confidential.

4.5. Reviewers must ask the Editor for permission to discuss the paper with others for specific advice, giving names and reasons for such consultation.

4.6. Reviewers must not pass the manuscript to another to carry out the review without permission from the Editor.

4.7. Reviewers must not use information, data, theories, or interpretations of the manuscript in their own work unless that manuscript is in press, published or the author has given permission to do so.

4.8. Reviewers should clearly support and justify the basis for their review analysis.

4.9. Reviewers should alert the Editor to similar manuscripts published or under consideration for publication elsewhere in the event they are aware of such. However, it is the responsibility of the Editor, not the reviewer, to decide on the proper course of action once so informed.

5. Citation Manipulation

5.1. Citation manipulation is considered unethical. Manipulation may include adding citations not contributing to a manuscript's content or solely aiming at increasing an author's or a journal's citations.

6. Sanctions

6.1. Suspected breaches of this policy may be handled by the Editor or may be forwarded to the Editorial Board for review and recommendation.

6.2. If an *Editor* is determined to have violated the **TJHE Ethical Guidelines for Publication**, the matter will be referred to the Editorial Board.

6.3. If an author is determined to have violated the **TJHE Ethical Guidelines for Publication**, TJHE reserves the right to impose sanctions, which may include restriction from further consideration of accepting the author's work, retraction of a published paper, or withdrawal of a submitted paper.

Date: 16 March 2015

Approved by the TJHE Editorial Board and signed on behalf of the Tuning Academy by:

Pablo Beneitone
Director, Tuning Academy (Deusto)

Robert Wagenaar
Director, Tuning Academy (Groningen)

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Tuning Academy

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