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The factor human capital in interdisciplinary research: A literature study

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INTERDISCIPLINARY RESEARCH AND HUMAN CAPITAL

COVID-19, global warming and protecting our privacy online are just a few examples of the complex problems that our society nowadays is confronted with. To address these and other complex problems an interdisciplinary approach is needed (Müller & Kaltenbrunner, 2019). In such an approach a problem is studied using different scientific perspectives and the solution is retrieved using the combination of these different perspectives. This solution transcends each of the individual perspectives (i.e., there is a synergy). A similar process occurs for entrepreneurship and innovation (Müller & Kaltenbrunner, 2019; Flemish Advisory Council for Innovation & Enterprise 2018). Research that entails the collaboration between scientific disciplines and the integration of information, techniques, tools, perspectives, concepts and/or theory from the different disciplines to reach synergies, is called interdisciplinary research by ECOOM (see also COSEPUP, 2004).

Because interdisciplinary research is essential for our increasingly complex society and innovation, universities and external funders have considered how they can encourage researchers to conduct interdisciplinary research (see for instance Leahy & Barringer, 2020). In Flanders this has led to the establishment of a separate panel for interdisciplinary research applications at FWO and diverse interdisciplinary research initiatives by the universities. Examples are the Interdisciplinary Research Program (IRP) at the Vrije Universiteit Brussel, interdisciplinary research consortia at Ghent University, the program 'Big projects' at Hasselt University, research excellence consortia at the University of Antwerp and the interdisciplinary networks at KU Leuven. An interuniversity initiative is the iBOF-program. Additionally, several Flemish universities introduced the interdisciplinary doctorate. After defending this type of doctorate researchers obtain the title "Doctor in interdisciplinary studies" or a combined doctors title. In the academic year 2019-2020 very little interdisciplinary doctorates were defended, certainly when compared to the total number of doctorates defended (see Table 1 for an overview for each Flemish university). These low numbers are easily explained due to the recent founding of such interdisciplinary initiatives and doctorates. Additionally, it takes approximately five years for doctoral candidates in Flanders to finish their (interdisciplinary) doctorate (ECOOM, 2019). Also, the number of doctorates with an interdisciplinary character is possibly higher than the numbers reported in Table 1 because not all doctorates with an interdisciplinary nature are officially registered as an interdisciplinary doctorate.

Table 1. Number of interdisciplinary and total number of doctorates defended at the Flemish universities in the academic year 2019-2020.

Flemish university	Number of interdisciplinary doctorates	Total number of doctorates
KU Leuven [a]	-	745
University of Antwerp [b]	-	264
Ghent University [c]	4	691
Hasselt University [d]	-	52
Vrije Universiteit Brussel [e]	2	211

Note. [a] It is possible to ask for a combined doctors title for an interdisciplinary doctorate since September 2019. [b] The interdisciplinary doctorate was introduced in the academic year 2019-2020. [c] The interdisciplinary doctorate was introduced in the academic year 2016-2017. [d] It is possible to conduct interdisciplinary research for a doctorate but the label "Interdisciplinary doctorate" as such is not used. The number of doctorates with an interdisciplinary character is not registered. [e] The interdisciplinary doctorate was introduced in 2011.

From the previous paragraph it becomes clear that Flanders wants to invest in interdisciplinary research and that several interdisciplinary research initiatives exist at the Flemish universities. But what about the factor human capital in interdisciplinary research? A literature study was conducted to look at interdisciplinary research from the perspective of human resources. The current brief summarizes the limited literature and answers the next research questions:

1. *Who conducts interdisciplinary research?*
2. *What characteristics of researchers facilitate successful interdisciplinary research?*
3. *Is interdisciplinary research an added value for the careers of researchers?*

These research questions are focused on the researcher as an individual. The context in which researchers work such as their research team, their department, their discipline, and the culture and organization of their university, also play a role in interdisciplinary research but are not the focus of this ECOOM-brief. We invite the reader to read the findings reported in this brief with the following question in mind: can we expect that these also apply to our Flemish universities? To make sure that the reader can answer this question regarding the generalizability of the scarce studies about human capital in interdisciplinary research, we provide some information about the studies themselves.

WHO CONDUCTS INTERDISCIPLINARY RESEARCH?

Several *socio-demographic characteristics* of researchers may determine who conducts interdisciplinary research. A study among researchers who obtained their doctorate in the United States of America (USA) in the academic year 2009-2010, shows that international young researchers are more inclined to do interdisciplinary research during their doctorate (Kniffin & Hanks, 2017). Also, a survey in 2006 among researchers from the faculty sciences, geosciences and biomedical sciences at Utrecht University (The Netherlands) demonstrates that female researchers, researchers from the applied and biomedical sciences and researchers who worked at different universities, companies or governmental organizations, conduct more interdisciplinary research (van Rijnsoever & Hessels, 2011).

In addition to socio-demographic characteristics, the *motivation* of researchers would also determine their engagement in interdisciplinary research. The Royal Flemish Academy of Belgium for Science and the Arts (Waelkens, 2019) suggests that researchers in Flanders are probably more inclined to conduct interdisciplinary research if it offers them an intellectual added value.

Finally, also the *personality* and the *behavior* of researchers determine the extent to which they do interdisciplinary research. Policy makers in the United Kingdom for instance pointed out in 2013 that researchers conduct more interdisciplinary research when their personality is characterized by self-confidence and an open mind for interdisciplinary research (Prager et al., 2015). Looking at their behavior, researchers who were on the one hand employed by the Imperial College London and on the other hand entrepreneur between 2001 and 2011, were exploring more alternative topics and these had a higher degree of integration in their own research (Fini et al., in press).

WHAT CHARACTERISTICS OF RESEARCHERS FACILITATE SUCCESSFUL INTERDISCIPLINARY RESEARCH?

The *socio-demographic characteristics* of researchers do not only partially determine who engages in interdisciplinary research, but also determine the success of interdisciplinary initiatives. Data collected among researchers who obtained their doctorate in the USA in the period 2003-2015, demonstrate that international researchers, graduates from a private institution and men are more successful in finishing an interdisciplinary doctorate (Golembiewski et al., 2018). It may now seem as women do more interdisciplinary research than men (see Research question 1), but men are more successful at it than women. However, the context in which the studies were conducted differ too much from one another to conclude this (e.g., the one study was conducted among doctorate holders from all universities in the USA vs. the other study was conducted among researchers at specific faculties at one university in the Netherlands).

What *competencies or skills* do interdisciplinary researchers need to successfully conduct interdisciplinary research? On the one hand they need skills that are useful for any type of research collaboration. According to Lyall and Meagher (2007, United Kingdom) team working skills, being flexible and being able to adapt are some examples of important competencies. On the other hand a number of specific skills are required. Claus and Wiese (2019, Germany) recently identified four competencies that specifically foster the success of interdisciplinary research. The first competency is taking initiative for exchange. This means that researchers promote interdisciplinary collaboration, for instance, by starting concrete discussions and proposing solutions for problems. The second competency is tailoring communication to the target group by translating jargon and being patient when explaining things. Third, knowledge integration or thus the integration of several perspectives is important (see also Carr et al., 2018, Austria; Lyall & Meagher, 2007 and Prager et al., 2015, United Kingdom; Morse et al., 2007, USA/Costa Rica). The fourth and final competency is being able to reflect about one's own discipline (e.g., thinking about limitations and assumptions) and to appreciate other disciplines (e.g., valuing diversity and taking other approaches seriously, see also Reich & Reich, 2006, USA).

Finally, would the *personality* of researchers also play a role in whether or not interdisciplinary research is conducted successfully? According to researchers from the United Kingdom (Lyall et al., 2011; Lyall & Meagher, 2007) the answer to this question is "yes". Patience, ambiguity tolerance and being open-minded for ideas and experiences from other disciplines would have a positive influence on being successful in interdisciplinary research. In the United Kingdom openness hence seems to be positively related to both engaging in interdisciplinary research (see Research question 1) and successfully conducting it.

IS INTERDISCIPLINARY RESEARCH AN ADDED VALUE FOR THE CAREERS OF RESEARCHERS?

The PhD Career Survey conducted by ECOOM-Ghent University shows that doctorate holders who obtained their doctorate at a Flemish university have both academic and non-academic careers (see ECOOM-brief 25). Hence, it is interesting and relevant to look at the impact of interdisciplinary research on each of these careers.

For *academic careers* mixed findings are found regarding the impact of interdisciplinary research. On the one hand interdisciplinarity is little valued on the academic labor market. Teaching is often an important aspect of academic positions and courses are mainly discipline specific (Weingart, 2014). Additionally, evaluation systems of Italian, Swedish and Dutch universities predominantly reward monodisciplinary research (Donina et al., 2017; Müller & Kaltenbrunner, 2019; van Rijnsoever & Hessels, 2011). For instance, collaboration within a discipline has a positive effect on one's academic rank at the faculties sciences, geosciences, and biomedical sciences at Utrecht University, but interdisciplinary collaborations have not (van Rijnsoever & Hessels, 2011). Accordingly climate scientists from 56 different countries mention that interdisciplinary research goals conflict with expectations related to tenure positions (Hein et al., 2018). In Flanders the Young Academy points out that interdisciplinary research mainly negatively affects young researchers: they are confronted with evaluations in quick succession while interdisciplinary research demands more time and it takes longer to obtain results (Geris & Op de Beeck, 2015). This has resulted in less publications in the USA (Leahey et al., 2017). On the other hand these interdisciplinary publications are more frequently cited by other researchers in the USA (Leahey et al., 2017). Also, doctorate holders in STEM and social sciences in the USA who engage in interdisciplinary research, have a larger chance of obtaining an academic position and have the same type of positions as researchers not involved in interdisciplinary research (Millar, 2013).

Regarding *non-academic careers,* only one study was found, namely a study about the impact of an interdisciplinary doctorate on salary. For the USA Hanks and Kniffin (2014) discovered that the salary of doctorate holders who obtained their interdisciplinary doctorate in the academic year 2009-2010 is not lower but also not higher than that of doctorate holders with a monodisciplinary doctorate obtained in that same academic year. These results were found irrespective of the discipline the doctorate was obtained in and the sector of employment (i.e., industry, government or non-profit). Yet, in a number of specific situations the interdisciplinary aspect of the doctorate did affect the salary doctorate holders received: (1) in the sector 'government' researchers with an interdisciplinary doctorate obtained in business obtained a higher salary than doctorate holders with a monodisciplinary business doctorate and (2) in the non-profit sector researchers with an interdisciplinary doctorate obtained in the health sciences earned less than those with a monodisciplinary doctorate in the health sciences.

DISCUSSION

Until now, little scientific research has focused on choosing for interdisciplinary research, the start, development and execution of it in interdisciplinary teams and the influence of it on the careers of researchers, both inside and outside of universities. In this ECOOM-brief we present our findings based on the existing literature. This literature has barely scratched the surface. Moreover, the literature is almost exclusively international and focusses on university systems and labor markets that sometimes differ from the Flemish one. Some caution is hence warranted when extrapolating findings to the Flemish context.

It is clear that Flanders wants to invest in interdisciplinary research and that Flemish universities have several interdisciplinary research initiatives. Also, there are some reflections on the factor human capital in interdisciplinary research in Flanders. For instance, the Royal Flemish Academy of Belgium for Science and the Arts (Waelkens, 2019) suggested that Flemish researchers would be more inclined to conduct interdisciplinary research if they see the intellectual added value of it. Based on an internal survey and a debate about interdisciplinary research with the responsible persons for science policy from all Flemish universities in 2013, the Young Academy (Geris & Op de Beeck, 2015) drafted a report on the challenges associated with interdisciplinary research for young researchers and how one can address these challenges. However, in general we have little insights into the factor human capital when the focus is on interdisciplinary research in a Flemish context.

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