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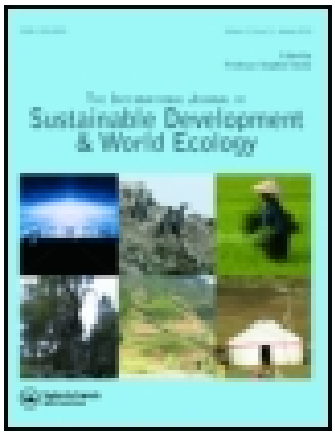

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Higher education level teaching of (master's) programmes in sustainable development: analysis of views on prerequisites and practices based on a worldwide survey

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The concept of sustainable development (SD) has highly been debated since it was presented 25 years ago, with 'hard science' approaches on one side and more process-oriented approaches on the other side. Academic teaching in SD has emerged in response to this in very different contexts, partly mirroring this academic debate. Some master's programmes in SD take a strong science approach, while other programmes focus on the process of implementing sustainability projects, sometimes connected with forms of action research and teaching. In this article, we identify diverse views on the concept of SD as well as views on most relevant modes of teaching. We discuss core competencies required for sustainability professionals in their working practices and we organise them in three main clusters: Know, Interact and Be (KIB). The article presents the results of a worldwide survey, which addresses these visions on the concept of SD, the capabilities needed for 'sustainable development professionals' and the teaching approach needed. The analysis is based on the responses of 54 lecturers and 287 students active in 34 SD master's programmes on all continents. The results of this worldwide survey are discussed. We observe in practice some gaps between preferences and practice. Looking at what both lecturers and students see as essential topics to address, some topics get relatively less attention (like the population issue). The identified core competencies (KIB) are supported and all addressed in practice, while the 'Be' competencies receive relatively less attention. Suggested consequences for academic teaching include a further matching of programmes with perceived needs and bridging the gap between the experienced teaching approaches in practice with such identified needs.

Keywords: sustainable development; academic teaching; competencies; educational vision; master's programme

1. Introduction

Reports from renowned scientific communities, such as the Millennium Ecosystem Assessment (UNEP 2005), the Fourth Assessment Report by the International Panel on Climate Change (IPCC 2007) and the 2011 Human Development Report (UNDP 2011), simultaneously express a strong message about the state of the planet and the living conditions of the poor. Human societies worldwide are coping with huge and persistent sustainability issues like population growth, resource depletion, global warming and loss of biodiversity (Kates et al. 2001).

Solving these issues requires the swift growth of a new class of professionals at all employment levels, ranging from people working in the field to academic professionals. In this article, we focus on academic master's programmes in sustainable development (SD), aiming at producing the last category of experts. A main goal of these programmes is to prepare students to be the future 'problem solvers' or 'change agents' (Leal Filho & Wright 2002; Blewitt & Cullingford 2004; Skanavis & Sarri 2004) by teaching them the right skills, knowledge and attitudes (also referred to as competencies). Many publications (Blewitt & Cullingford 2004; Skanavis & Giannoulis 2009; Jones et al. 2010; Jerneck et al. 2011; Spangenberg 2011; Wiek et al. 2011; among others) stress that higher education in SD is vital in the transition towards sustainability. Moreover, they claim that the field is not using its full potential. Conventional modes of SD education and the mainstream trend in higher education towards specialisation are not considered to provide the right competencies to produce graduates capable of accelerating change towards a sustainable future (Gibbons et al. 1994; Klein 1996; Khan 2002; Polk & Knutsson 2008; among others). Rather than focusing on the transfer of knowledge, higher education in SD should focus on enhancing the capacity of individuals and organisations to make change and transformation possible (Landorf et al. 2008; Reunamo & Pipere 2011). Also, in order to 'produce' graduates who are capable of accelerating change towards a sustainable future, higher education institutions should educate generalists, who are able to look at sustainability issues from a range of disciplinary angles, cultural perspectives, spatial perspectives and different time spans (Norbert-Hodge 2000, p. 189). For this, a *transdisciplinary* approach is widely advocated (Kates et al. 2001; Allen-Gil et al. 2005; Scholz et al. 2006; Lang et al. 2012).

Fortunately, efforts to make higher education more influential in accelerating change towards a sustainable future are being made, such as the initiatives and debates around the concept of 'Education for Sustainable

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Development' (ESD) (UNESCO 2014) and the proclamation of the period 2005–2014 as the UNESCO Decade for Education for Sustainable Development (DESD) (Mul & Tilbury 2011; Wals 2012). Many universities have developed SD master's programmes and added transdisciplinary projects to their curriculums (Gil et al. 2005; Alvarez & Rogers 2006; Scholz et al. 2006; Stauffacher et al. 2006; Lang et al. 2012; Bootsma et al. 2014).

A change of educational culture towards transdisciplinary knowledge production, however, requires an institution to go through a deep learning process and asks a lot of programme directors and teaching staff (Sterling 2004, p. 58). Possibly for this reason, some scholars claim to see a gap between good intentions and actual implementation, making it unclear, however, what modes of SD education currently dominate in SD master's programmes (Rowe 2007). An often-read recommendation in the UN-related documents on ESD is the advice to universities to cooperate. The first step in this process is *to know what the others are doing*. This is exactly what was lacking in the literature that can be found on higher education in SD: an overview of *what is taught* about SD and *how* SD *is being taught* in the numerous interdisciplinary SD master's programmes nowadays existing worldwide. Moreover, the theories developed on higher SD education teaching methods, including the transdisciplinary case study method, are to a large extent based on personal experiences of the authors at the universities where they are active. These theories do not necessarily hold for other SD master's programmes. It would be highly relevant to produce an overview of *what is taught* about SD and *how* SD *is being taught* worldwide. In this article, we therefore aim to assess to which extent the above observations of a gap between intentions and practice actually exist. Furthermore, we intend to find out to what extent the various views on *what* and *how* SD *should* be taught are supported in practice, according to both the future sustainability professionals (the students) and the lecturers. With this empirical study, we create a contemporary overview of the current status of teaching in SD master's programmes worldwide as well as a contemporary overview of the level of consensus on what these programmes *should* look like, according to their students and lecturers, to help students in becoming future change agents. The following research question was used for this study:

> In what way is sustainable development being taught in sustainable development master programmes, and how does this relate to views in academic literature on the competencies that sustainable development students should develop (to become future change agents)?

2. Views on SD teaching and competencies needed for SD professionals

2.1. *History*

A web search by Van de Keere (2012) on SD master's programmes indicates that there were more than 50 multidisciplinary or interdisciplinary SD master's programmes in 2010 worldwide. This has not always been the case. In the history of environmental education, and what later became education in SD, a link can be identified between the changing concerns about the environment and its associated problems and the way in which environmental education developed (Tilbury 1995; Leroy 2004). This was already the case in the early 1970s when environmental education emerged as a product of the, by that time, unprecedented concern about the environment and the future of the planet. This concern was raised in a number of well-known and alarming publications on the state of the environment, like Carson's (1962) 'Silent spring' and the Club of Rome report 'Limits to growth' (Meadows et al. 1971). In that period, environmental education was not accepted as a concept in its own right, but instead was developed as additional optional courses in a diversity of disciplines. In the decades that followed, the nature and scope of environmental education broadened to an interdisciplinary and global approach. The concept of 'sustainable development' became part of the vocabulary of environmental education no earlier than the 1990s, in response to the Brundtland report (WCED 1987; Tilbury 1995).

The 1992 Rio Summit, through Agenda 21, identified a wide range of strategies for achieving sustainability, in which education was identified as one of the most important tools for SD (UNCED 1992; Coriddi 2008). Education was seen as a means of raising environmental awareness, not only across the public at large but, in time, also among key decision-makers in governments and businesses (Chalkley 2002). The progress made by the Agenda 21 initiatives in the years that followed, however, was considered inadequate, and the concept of 'ESD' was introduced after an international debate on how to reshape SD education. ESD could be described briefly as 'the process of learning how to make decisions that consider the long-term future of the economy, ecology and equity of all communities' (Calder & Clugston 2005, p. 34). An extra effort was made to promote SD education by proclaiming the period 2005–2014 as the UN DESD (Calder & Clugston 2005).

The UN DESD brought SD education leaders and stakeholders together to determine the resources, research priorities and strategies that were needed for making SD a major priority of higher education (Calder & Clugston 2005). This resulted in a prominent role for higher education in the 'DESD'.

There are different ways for SD to be incorporated into higher education: one is to incorporate it into all programmes at a university and to ensure that graduates with all kinds of degrees are all 'sustainable development-literate'. The other option is to produce SD specialists in SD programmes (Sherren 2006). The focus of this article is on the latter: teaching sustainability professionals in academic SD master's programmes and its societal impact.

SD master's programmes are based on a certain vision of the way that SD has to be taught in a SD master's

programme. Usually, this vision is generated by the programme leaders of a SD master's programme together with associated teaching staff, the university's board and other university members. A number of educational visions dominate the discussions on what type of education fits best with the kind of knowledge, skills and attitudes students should learn in their master's programme. These educational visions are also called 'pedagogical concepts', 'pedagogical visions', 'discourses', 'educational concepts' or 'types of knowledge production' (Hessels & van Lente 2008), but for this article, we use the term 'educational vision' consistently.

The same educational visions that are described in this paragraph can be found in similar discussions on the way that research should be done (Stauffacher et al. 2006). This is not surprising, because education and research are both a form of knowledge production and both forms struggle with the same questions: how to study complex issues like climate change or globalisation.

In describing SD master's programmes, we will focus on three components: content, educational views and competencies addressed.

2.2. Content

Raising the question of the required content of an academic SD master's programme is like opening Pandora's Box. It immediately leads to an endless debate about the content to be included, basic principles, normative positions, definitions of the concept of SD and more. We take a general view here, by looking at the key issues addressed in the global arena on SD. As a world community, we are facing major persistent threats, which have already been known for a few decades (WCED 1987), but which are still far from being solved or even still increasing. We observe that the same issues addressed in the Brundtland report (Chapters 4–9) continue to be major challenges on the agenda of our global institutions. These persistent threats are:

- continuing population growth, linked to poverty and food security (UN DESA 2004; UN Population Division 2012);
- which globally drives urban sprawl and the growth of unhealthy megacities (UNEP 2011);
- with an increasing volume of human consumption and affluent consumption patterns in growing parts of the world, which is enabled by still very inefficient modes of production, and (also as a result of the first two threats) accelerating depletion of crucial mineral and water resources (Fischer-Kowalski & Swilling 2011);
- and as an essential part of that, the carbon-based energy system, which results in climate change and its additional ecological and social impacts (IEA 2010) and
- which are just a part of a far wider scope of effects on our global ecosystems and biodiversity losses (UNEP 2005).

There is a fairly wide academic consensus about the main solutions, including the creation of a circular economy, reducing its dependency on virgin resources; shifting from a carbon-based energy system to renewable energy resources; while also addressing poverty with the UN Millennium Goals; and poverty-oriented production approaches, like Bottom of the Pyramid, and addressing institutional causes of unsustainability in the globalised economy (UNEP 2011).

2.3. Educational visions

The second component in describing the teaching practices is the educational visions applied. We briefly discuss here four educational visions: the disciplinary approach, interdisciplinary approach, transdisciplinary approach and the personal value development approach.

Higher education and academic research are traditionally divided into different *disciplines*. Disciplinary research or education takes place within the boundaries of a single academic discipline and focuses on disciplinary aspects of a problem in isolation, using an 'objective' analytical perspective (Becher & Trowler 2001; Winder 2003; Krishnan 2009). This prevailing design of education and knowledge into disciplines has its roots in rationalism, in which knowledge is expected to be derived from an 'empirical evidence-based', 'rigorous', 'value-free' and 'scientific' understanding of the world (Sipos et al. 2008). Science practiced in this way ideally leads to objectivity, certainty, universality and predictability (Phelan 2004). Disciplinary research therefore is often associated with 'methodological rigour' and 'control for error', 'going deep into the subject' and 'exactness' (Van den Besselaar & Heimeriks 2006). Disciplinarity is also referred to as 'mode 1' knowledge production (Gibbons et al. 1994; Lang et al. 2012). For the purpose of this study, we separate two elements of this 'mode 1' knowledge production: the *empirical value-free* research approach and the pulling apart of the complex reality in separate *subdisciplines*.

While subdisciplinarity is still appreciated for certain characteristics, such as 'rigorous', 'objective' and 'digging deep', opponents blame subdisciplinarity for being static, conservative, adverse to innovation (Van den Besselaar & Heimeriks 2006) and splitting scientific knowledge into smaller and smaller, increasingly irrelevant pieces (Sipos et al. 2008).

New ways of doing research in which subjects are studied simultaneously involving different disciplines (instead of a single discipline) started to emerge from the 1970s onwards (Klein 1996). These new forms of interactive research are known under a number of names of which *interdisciplinary* research and *transdisciplinary* research are the most widely known. The main differences between these concepts are the intensity of cooperation and integration of disciplines and the involvement of non-academic fields (Ceccon & Cetto 2003; Winder 2003).

In interdisciplinary studies, involving several academic disciplines (within the social sciences or the natural sciences, or from both the natural and social sciences), discipline-related subject boundaries are crossed to create new shared (nondisciplinary) knowledge and theory and solve a common research goal (Winder 2003; Tress et al. 2006). The fact that subject boundaries are crossed to create new knowledge makes *interdisciplinarity* fundamentally different from *multi-disciplinarity* in which the subject boundaries are not crossed, but various disciplines collaborate while still working from their own perspective. Multidisciplinarity is not included in this paragraph (and the questionnaires) because of the limited attention it is given nowadays both in research and higher education (Spangenberg 2011).

Interdisciplinarity became a buzzword in scientific debates, and many research-funding organisations have promoted it as the desirable direction towards which the social and natural sciences should develop themselves (Spangenberg 2011). Interdisciplinary research is also associated with creativity and progress, as several intellectual 'breakthroughs' were achieved by crossing disciplinary boundaries (Morrilo et al. 2003).

Transdisciplinary research goes one step further than interdisciplinary research. In transdisciplinary knowledge production, it is not only researchers from different disciplines but also nonacademic actors, who participate in studying a common issue and creating new knowledge and theory (Tress et al. 2006). Nonacademic participants can be all kinds of societal actors, such as policymakers, representatives of administration, business, interest groups, local residents or the broader public (Brundiers & Wiek 2011; Lang et al. 2012).

It is this transdisciplinary problem-based research, which integrates academic and nonacademic knowledge, which is referred to as mode 2 knowledge production. Mode 2 is quite widely acclaimed and promoted as the way to go in SD research and education (Kates et al. 2001; Allen-Gil et al. 2005; Alvarez & Rogers 2006; Scholz et al. 2006; Brundiers & Wiek 2011). The arguments are the following: (1) the complexity of sustainability issues asks for different types of knowledge and different sources of knowledge (Cash et al. 2003), (2) conventional ways of knowledge production prove unsatisfactory in dealing with the full complexity of environmental management (Ludwig et al. 2001) and, moreover, (3) do not succeed sufficiently in integrating local stakeholder perspectives into the development of environmental management strategies (Olsson & Folke 2001; Raymond et al. 2010; Khan et al. 2012). That being said, a good deal of criticism, summarised by Hessels and van Lente (2008), has been raised against the transdisciplinary knowledge production philosophy, including notes on supposed lack of reflexivity, quality control and disregard of the scientific practice that is already there.

The fourth approach, the *personal value development* approach, is less linked to the debate on modes of knowledge production, but rather takes the position of the professional in society as a starting point. In science, a researcher traditionally tries to be as objective and value-free as possible during his study. The recognition of the limitations of relying solely on rationalism, however, has resulted in pleas to reacknowledge humanist values and an acknowledgment of human fallibility (Saul 1997; Sipos et al. 2008). Supporters of this educational vision ask universities to take their share of responsibility, pointing to the fact that the threat to the planet is largely the result of work by people at BSc, MSc and PhD levels (Orr 2002). SD change agents should have a value system and self-perspective to support, weigh and ground their actions as change agents (Svanstrom et al. 2008). Furthermore, SD graduates need to recognise different value-laden concepts, not to position them in value-laden debates, but to facilitate dialogues between stakeholders in practice (Orr 2002).

These various discourses on appropriate educational approaches may tend to be seen as mutually exclusive. However, the debate on which approach is most suitable for teaching different aspects of SD is still unresolved. We may follow the line of Sherren (2006, p. 402), who suggests that disciplinary and transdisciplinary research should coexist as 'you cannot generalize specialist scientific knowledge to develop structures for human behaviour and ethics, nor can you use big-picture knowledge of a system to solve problems without specific domain knowledge'. He also states that not one particular approach is the most perfect one, because each institution should build on its own strength (Sherren 2005). We would add to this that the situation in different countries, cultures and labour markets for SD professionals will be different and teaching approaches should be attuned to that as well. Therefore, it makes sense to analyse to what extent the various educational approaches are applied in practice (not as mutually exclusive approaches, but rather in a mix, because academic master's programmes usually consist of large sets of elements during one to sometimes three years of teaching) and to what extent the various approaches are perceived to be required in different countries.

2.4. *Competencies*

One of the main complaints brought about in the discussion on educational visions is that the trend in higher education towards further specialisation, together with traditional teaching styles, does not produce the sufficient knowledge, skills and attitudes to produce graduates capable of accelerating change towards a sustainable future (Gibbons et al. 1994; Klein 1996; Khan 2002; Polk & Knutsson 2008; among others). The types of knowledge, skills and attitudes students should develop in their studies is commonly referred to as 'competencies' (Baartman et al. 2007) and generally refer to explicit expectations of what a student will be able to do as a result of a learning activity. 'Sustainable development competencies', competencies that are particularly relevant for SD students, are defined as 'types of knowledge, skills, and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems,

challenges, and opportunities' (Dale & Newman 2005; Baartman et al. 2007).

The advantage of using the competencies concept is that it enables us to have an explicit and commonly shared framework to characterise education programmes and graduates (Baartman et al. 2007; Wiek et al. 2011). For SD programmes, such a framework could function as a useful reference for the development of the knowledge, skill and attitudes profile that students should possess in order to become a future transition manager working on SD (Rowe 2007; Wiek et al. 2011).

However, in these debates, it is not always clear what types of competencies are exactly referred to. Therefore, in this article, we propose a framework of 'the most important types of knowledge, skills and attitudes sustainable development students should possess after graduation', based on a review of both higher education literature and higher SD education literature.

A document from the Joint Quality Initiative called 'the Dublin Descriptors' forms the European standard for the competencies that students should acquire in higher education programmes (Meijers et al. 2005). The Dublin Descriptors are widely implemented; these competencies were therefore chosen to represent the set of competencies *every* academic student should learn. We compared these general competencies with the competencies listed in a well-cited OECD publication of the 'Definition and Selection of Competencies Project' (OECD 2005). The list of competencies from the Dublin Descriptors was complemented by a list of competencies, created by Wiek et al. (2011), which was specifically created for SD students based on literature on specific SD competencies. Their framework is a first attempt to synthesise the literature on SD competencies into an over-arching framework of SD competencies. These competencies have also been identified by authors not included in the analysis by Wiek et al. (2011) (Kates et al. 2001; Runhaar et al. 2005; Barth et al. 2007; Svanstrom et al. 2008; Brundiers et al. 2010; Bootsma & Vermeulen 2011; Khan et al. 2012; Nielse 2012). Combining this information, a total of 11 unique competencies were defined. These competencies can be clustered into three main fields and organised in a hierarchy of increasing complexity and difficulty, where competencies shown lower in each column are requirements needed for the competencies higher in the same column. We briefly describe them in Table 1.

Summarising the debates about competencies for SD professionals in this way, the key empirical question now is: to what extent are these various competencies addressed in practice and what perceptions do scholars in SD (both students and lecturers) have about the relative importance of these various clusters of competencies?

3. Research methods

To analyse the content, educational visions and competencies addressed in SD master's programmes, we carried out an online survey in 2012 amongst students and lecturers.

Table 1. Overview of the 11 competencies important for SD students arranged in the three clusters of competencies.

Competencies around intellectual abilities	Competencies around interacting	Competencies around self-development
Analysing, evaluating and crafting future scenarios: Being able to think in and work with future scenarios (e.g. climate change scenarios) related to sustainability issues	**Leadership and social skills:** Leadership, communicating and convincing: capable of managing conflicts in socially heterogeneous groups	**Act as a sustainability example:** Communicate your sustainability values. Live sustainable and show it. Help to change the world around you
Systems thinking and analytical/integrating capacity: Insight into context and working with *system models*: Analysing complex systems across different *domains* (society, environment, economy) and across different *scales* (local to global + temporal)	**Strategic competency and practical skills:** The ability to design and implement interventions/transitions towards sustainability. Including the ability to translate theory to practice and *to get things done*. Managing projects in unfamiliar environments with deadlines and inconclusive evidence	**Normative competency:** Personal value development and the understanding of the ethics of current and future social systems. The ability to map and apply sustainability values, principles, goals and targets
Professional knowledge: Knowledge of the natural and social science disciplines and relevant policy and legislation; so that it provides a basis for creativity in developing and/or applying ideas	**Using media interactively: the ability to bring a message across:** The use of language, information, knowledge, social media and computers to smartly communicate a message to accomplish a *broader goal*	**Self-management and acting autonomously:** Discipline, sense of responsibility, insight into personal qualities and limitations, setting priorities
Research and ICT skills: Research skills, statistical knowledge, GIS skills and high familiarity with other applied software	**Communicative skills:** Language proficiency, debating skills, skills for presenting to specialist and nonspecialist audiences	

Identifying master's programmes on SD is a complex task with two issues. First, there is a lack of central registration and, second, there is a great variety in the contents of programmes, somehow labelled with the adjective 'sustainable'. For the first issue, some online databases are available for North American and European academic programmes, but for other parts of the world, this is missing. The earlier mentioned web search by Van de Keere (2012) on SD master's programmes indicated that there were more than 50 multidisciplinary or interdisciplinary SD master's programmes in 2010 worldwide. Additional web search has been conducted. It has also been helpful that a meeting took place in 2011 of representatives of 14 academic master's programmes in SD from all parts of the world, who gathered to discuss the experiences, key characteristics and teaching requirements of their programmes. This allowed us to create commitment for the study and use a snowball method to identify more comparable programmes, especially outside Europe and North America.

For the second issue, the search boundaries, we only included master's programmes that are actually addressing SD as a comprehensive programme, with an interdisciplinary approach having inputs from both natural and social sciences. The numerous more focused programmes, like 'sustainable energy', 'sustainable water management', 'sustainable engineering', 'sustainable agriculture' as well as the programmes focusing on 'only' environment were excluded for reasons of narrow focus.

In this way, we have been able to identify and get commitment of 34 SD master's programmes from all continents. The survey received input from 287 students and 54 lecturers from 34 universities. An overview of participating programmes and response is available upon request. The master's programmes are clustered in five equally sized groups based on geographical region and development state of the country. The groups of programmes in developed countries are conveniently abbreviated as 'HIC1', 'HIC2' and 'HIC3' (higher-income countries), whereas the groups of programmes from developing countries are abbreviated as 'LIC/MIC1' and 'LIC/MIC2' (lower- and middle-income countries), based on the World Bank definition.

The questionnaire for students consisted of 26 closed (multiple-choice) questions and 1 open question, whereas the lecturers' questionnaire comprised 24 closed questions and 1 open question. Data collection took place between May and July 2012. The analysis of the survey was done using SPSS. To test for significant regional differences, the Student's *t*-test was used for interval variables and the Mann–Whitney U test for categorical variables ($\alpha = 0.05$) (Field 2009).

4. Results

In describing the practices of SD master's programme analysed, we will discuss each of the three components identified in Section 2: content, educational views and competencies.

4.1. *Content*

In the survey, we asked to what extent the issues mentioned in Section 2 (population growth, ecosystems and biodiversity loss, poverty and food security, energy system and climate change, inefficient production and consumption, urban sprawl and unhealthy megacities) have been addressed in their programmes. In Figure 1, we present the results for all students and lecturers together and the differences between the five regional groups of programmes. In the bars in the graphs in Figure 1, we displayed the cumulative percentages for the answers 'regularly' and 'main activity'.

Comparing the first bars in each of the six graphs, we see that most attention in the programmes is given to the topic of *energy system and climate change* (81% regularly or as manic activity). At some distance, this is followed by three topics: *ecosystems and biodiversity loss* (60%) and *poverty and food security* (57%) and *inefficient production and consumption* (56%). The topics of *urban sprawl and unhealthy megacities* (47%) and *population growth* (40%) receive the least attention in the programmes. Yet, despite these differences, we can conclude that all sustainability themes are given at least some attention in all programmes (few respondents filled in the 'never' category).

Figure 1 also reveals some regional differences in the topics addressed by the programmes studied.

Population growth is the least taught theme worldwide. However, there is a clear distinction between the representation in the higher and the lower/middle-income countries. The population growth theme is addressed considerably more in the lower/middle-income countries than in the higher-income countries. In programmes in Europe, Japan and Oceania, the issue is significantly less being taught than in other regions.

In all five regions, around 60% of the respondents stated that *ecosystems and biodiversity loss* is given attention on a regular basis or as a main activity in their programmes. This theme appears to be taught significantly less in Japan and Oceania.

Poverty and food security is given significantly less attention than in the programmes in Europe, Japan and Oceania and more than in the programmes in North America and in the lower-income countries.

Energy and climate change is very well represented in all programme groups. The theme is given the least attention in the North American programmes compared to the other groups, but it is not a significant difference.

The results on *inefficient production and consumption* show high similarities to the ecosystems and biodiversity theme: around half of the respondents in the HIC groups responded that the theme is given attention on a regular basis or as a main activity in their programmes. This percentage is around 70% in the lower-income countries.

Urban sprawl and unhealthy megacities is clearly only a main theme in the Stellenbosch and TERI programmes and, to a lesser extent, the other lower/middle-income countries' programmes. The least attention is given in

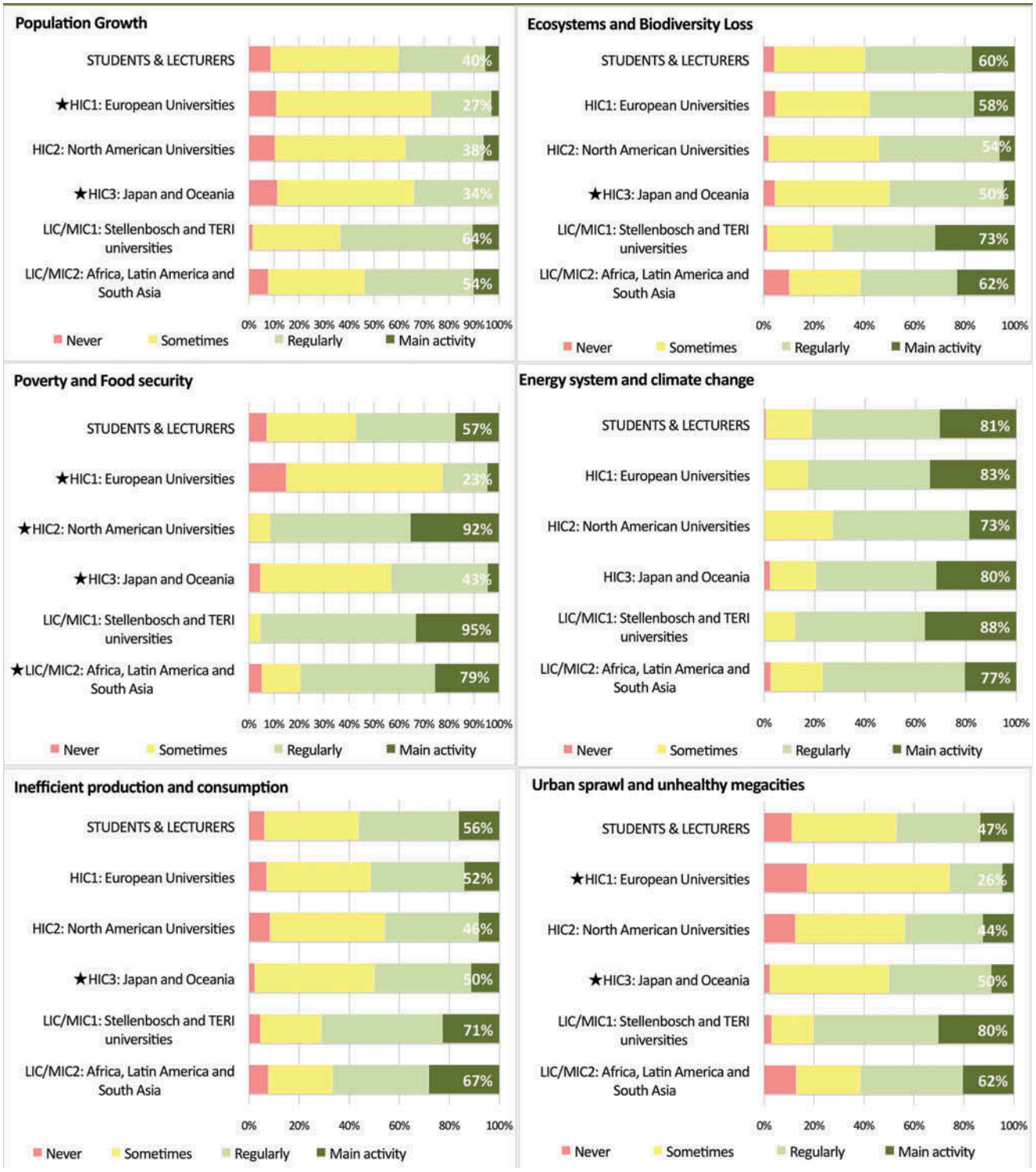

Figure 1. Representation of the sustainability issues in the content of the different programme groups. The percentages show the share of the two highest scales ('regularly' and 'main activity').

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (the average) (Mann–Whitney U: $\alpha = 0.05$) (total students and lecturers, $n = 325$; HIC1, $n = 128$; HIC2, $n = 48$; HIC3, $n = 44$; LIC/MIC1, $n = 66$; LIC/MIC2, $n = 39$).

the European programmes and in Japan and Oceania (significantly *less* than in the others).

There may be different grounds for these differences, such as the available expertise at the universities, the availability of finances for hiring academic staff, the market demand and the staff's views on most relevant sustainability issues.

We asked all respondents to assess the relative importance of the six worldwide sustainable issues, by asking how much time they would like to spend

on each of these topics in their *ideal* master's programme.

Here, we only present aggregate data, because we did not find large differences between regions and between lecturers and students for this question. Looking at the results for all respondents, we see variations in the importance attached to the six issues (Figure 2(a)). It gives the same pattern as shown in Figure 1 for the time spent on it in practice, but with a general wish for more time spent on each topic than given in practice (according to Figure 1):

- *Population growth* and *urban sprawl and unhealthy megacities* are given the lowest preference in the *ideal* programme, but respondents want more time for it than in practice;
- *Poverty and food security* as well as *ecosystem and biodiversity losses* are given a comparable middle position again with a request for more attention for it;
- *Energy system and climate change* and *inefficient production and consumption* are clearly given the greatest preference.

We also asked respondents to add other relevant topics, not included in the shortlist of six major persistent sustainability issues, if they felt some were missing. A fairly large share of them (42%) indeed added topics. In some cases, the answers could still be seen as a more specific topic related to any of the six core issues. Figure 2(b) gives the aggregated results of these suggestions. Partly, they stress problem areas in the social dimension of SD (equity, fairness, economic system, etc.), while others relate to problem areas in the environmental dimension (water, depletion). A third type of topics relates to the route for problem solving (education, governance).

4.2. *Educational visions*

In a comparable way, we asked students and lecturers to what extent the educational visions discussed in Section 2 are applied in the various courses in their programmes. Given the common practice of having a large list of courses during the one- to two-year programmes, some courses can represent one educational vision, while other courses may represent other visions.

In Figure 3, we present the results for all students and lecturers together ('worldwide') and the differences between the five regional groups of programmes. Again, in the graphs, the cumulative percentages for the answers 5, 6 and 7 (very much) are displayed.

The results confirm the argument and the pictures sketched in the reviewed literature in Section 2: the *interdisciplinary* educational vision is the best represented vision in the master's programmes, followed by the *transdisciplinary* vision. The high representation of the *interdisciplinary* educational vision is impressive, but was to be expected as we selected interdisciplinary master's programmes for the survey. Also, the relatively high representation of *transdisciplinarity* is an interesting result. This is the vision promoted by many as the way to go in SD research and education (Section 2). The opposite may be said about the *personal value development* vision, which seems to be far less represented in the programmes.

Here, we can observe a few remarkable regional differences. Programmes in the Japan and Oceania group focus significantly more than others on the 'value-free

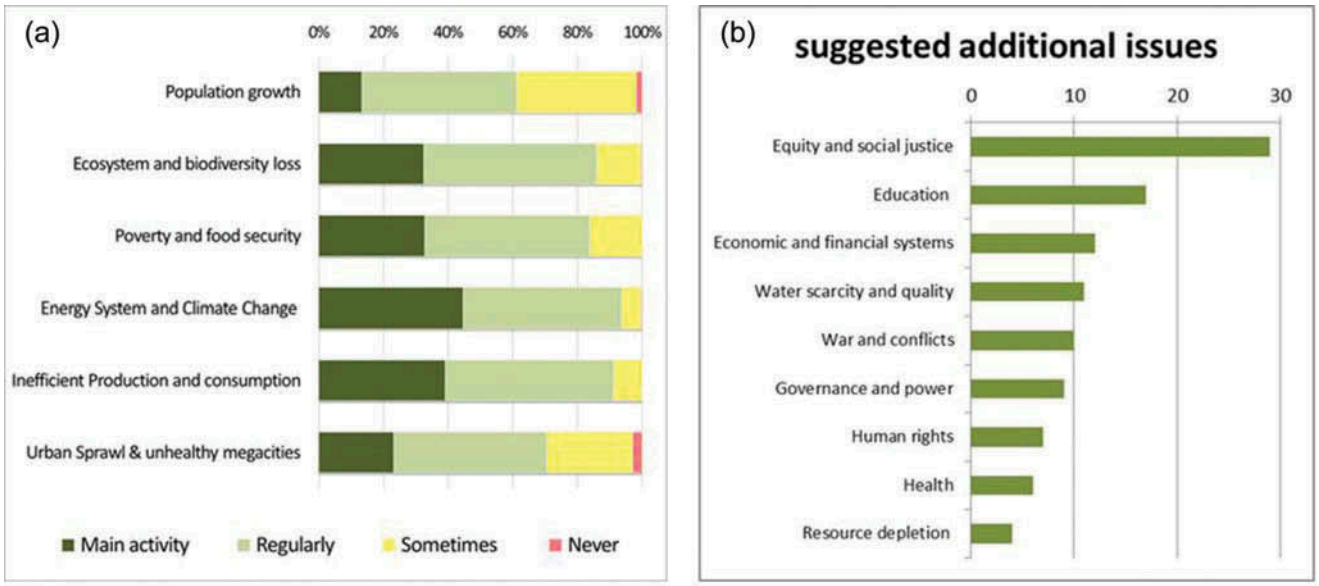

Figure 2. Most important worldwide sustainability issues. (a) According to the students and lecturers, time spent in an ideal sustainability master's programme on the six predefined sustainability issues (n = 271). (b) Sustainability issues indicated as missing in the list of six predefined issues (total n = 341; 143 respondents indicated crucial issues where missing/open answers have been categorised, showing the clusters mentioned more than three times).

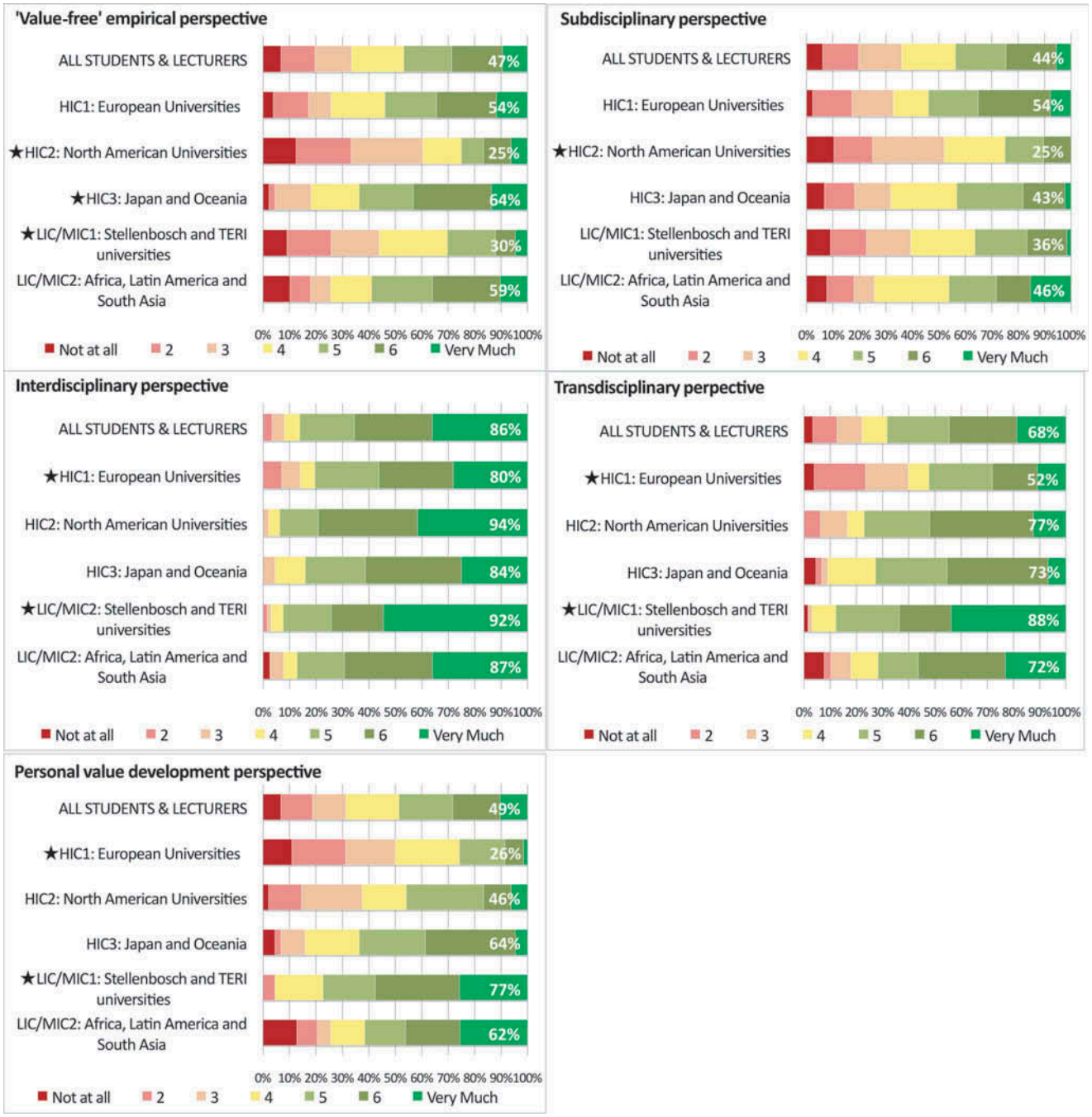

Figure 3. An overview of the representation of the five educational visions in SD master's programme in the five programme groups. The percentages show the share of the three highest scales (5, 6 and 7 'very much'). The groups are compared to total students and lecturers score (all students and lecturers).

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (the average) (Mann–Whitney U: $\alpha = 0.05$) (total students and lecturers, $n = 325$; HIC1, $n = 128$; HIC2, $n = 48$; HIC3, $n = 44$; LIC/MIC1, $n = 66$; LIC/MIC2, $n = 39$).

empirical' vision, while this vision is represented significantly less than elsewhere in the North American and the Stellenbosch/TERI programmes.

For the *disciplinary* vision, the highest representation can be found in the European programmes, this representation is higher than those of North America and Stellenbosch/TERI. The vision is represented significantly less than average in the North American programmes. Stellenbosch/TERI score also lower than the others average on disciplinarity.

The representation of the *interdisciplinarity* vision is significantly higher in the Stellenbosch and TERI universities' programmes. The North American programmes also score notably (but not significantly) higher than elsewhere on *interdisciplinarity*. The European programmes have the lowest

representation, not only significantly lower than others but also significantly lower than all other groups (Mann–Whitney U: $\alpha = 0.05$).

Transdisciplinarity scores are relatively high worldwide (represented (very) much according to 68% of the respondents), except for the European programmes that score significantly lower than the rest. Stellenbosch and TERI have a representation of transdisciplinarity in their programmes that is significantly higher than elsewhere.

The results on the *personal value development* vision are mixed. The representation at Stellenbosch and TERI is significantly higher than elsewhere. The second and third best representation can be found in the LIC/MIC2 group and Japan and Oceania. North America applies this less than others, while Europe applies this significantly less than others. The personal value development vision appears to be largely absent in programmes in Europe or is not identified as such by the respondents.

Next, we asked the respondents to give their views on the preferred balance of the distinguished approaches. Students were asked in what way they would prefer to be taught in their *ideal* SD master's programme. Similarly, lecturers were asked how important they consider the five visions in the teaching of (future) academic sustainability professionals. The results are given in Figure 4 for the students' answers. The answers of lecturers showed a fairly comparative pattern.

According to the students, SD master's programmes should mostly be interdisciplinary and transdisciplinary oriented. Personal value development should also have a prominent, but slightly smaller role in the programme. Students' views on the representation of the value-free empirical vision and disciplinary vision in the ideal master's programme are still mostly positive, with the subdisciplinarity vision receiving higher scores than the value-free empirical vision. This indicates that students prefer to learn about values, visions and integrative approaches, but in combination with facts and knowledge.

Again, we see some geographic differences. In the perceived 'ideal' programme, the 'value-free empirical' vision also received the lowest scores from all groups (except for the LIC/MIC2 group that gave the *disciplinarity* their lowest score). The North American students' preference for this vision is significantly lower than elsewhere. Students in Japan and Oceania and in the second lower-income countries group prefer a slightly higher representation of the 'value-free empirical' vision.

Students would like to see *disciplinary* teaching in their ideal master's programme, but do not want this vision to dominate (the percentages fluctuate around the 60%). Students in Europe, however, prefer a significantly higher representation (72%) than the students from North America and Stellenbosch/TERI. Looking back at the existing representation of this vision (Figure 3), the representation of the disciplinary vision is actually significantly higher in Europe than in North America and Stellenbosch/TERI.

The preferred presence of *interdisciplinarity* is equally as high as the perceived balance in the existing programme structures (averagely 89%). The three groups with the highest preference for this vision are also the groups with the highest existing representation of interdisciplinarity, North America and both lower-income countries groups.

While the *transdisciplinary* vision in practice showed to be relatively well represented in practice in the groups of programmes (averagely 68%, with a relative low for Europe, 52%), the students' preferred share of transdisciplinary teaching in their programme is notably higher for all groups (averagely 91%). Stellenbosch and TERI students' preferences for this vision are significantly higher than elsewhere. The actual representation of transdisciplinarity in these two programmes is already the highest, significantly higher than for others (88%).

The representation in practice of the *personal value development* vision turned out to be highly variable. What can be observed now, however, is that students from all but one group prefer a relatively high representation of *personal value development* teaching in their programmes. This group is Europe, where the students prefer a significantly lower representation of *personal value development* in their programmes. This matches with what was already seen in Figure 3, the representation in practice of this vision in the European programmes is significantly lower than all other groups (26%, see Figure 3). The preferences of students from Stellenbosch and TERI for this vision are significantly higher than elsewhere, which corresponds to the actual representation of the vision in these programmes, which is also significantly higher. The other programmes from Latin America, Africa and South Asia have the second highest preference for *personal value development* teaching and, indeed, have the second highest representation in practice.

If we compare the figures on preferences for each of the educational visions with the representation in practice (Figures 3 and 4), we see students' preferences are more or less in line with the respondents' preferred balance for the *value-free empirical* vision and *interdisciplinarity* vision, but they do prefer a stronger emphasis on *disciplinary* contents and on *transdisciplinarity* and *personal value development* in all of the regions.

4.3. *Competencies*

Finally, we present the results for the attention given in practice to the various clusters of competencies identified in Table 1 (Know, Interact, Be (KIB)) and the respondents' preferences in this respect: Figures 5–7 show the results for these three clusters of competencies.

4.4. *The 'Know' cluster*

Relatively little variation is found in this first cluster of competencies: with a few exceptions, the different geographic groups scores on each competency do not differ a lot from the score of all programmes together. K3 'systems

Figure 4. Overview of the preferred representation of the five educational visions in the *ideal* sustainability master's programme of the students of the five groups. The percentages show the share of the three highest scales (5, 6 and 7 'very much').

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (the average) (Mann–Whitney U: $\alpha = 0.05$) (total students, $n = 270$; HIC1, $n = 110$; HIC2, $n = 39$; HIC3, $n = 33$; LIC/MIC1, $n = 61$; LIC/MIC2, $n = 27$).

thinking and analytical capacity' is the best-represented competency of all the three clusters together, with little regional differences.

The highest-level competency K4 on 'future scenarios' is distributed very similarly in all programmes (around 73%) and relatively high in North America.

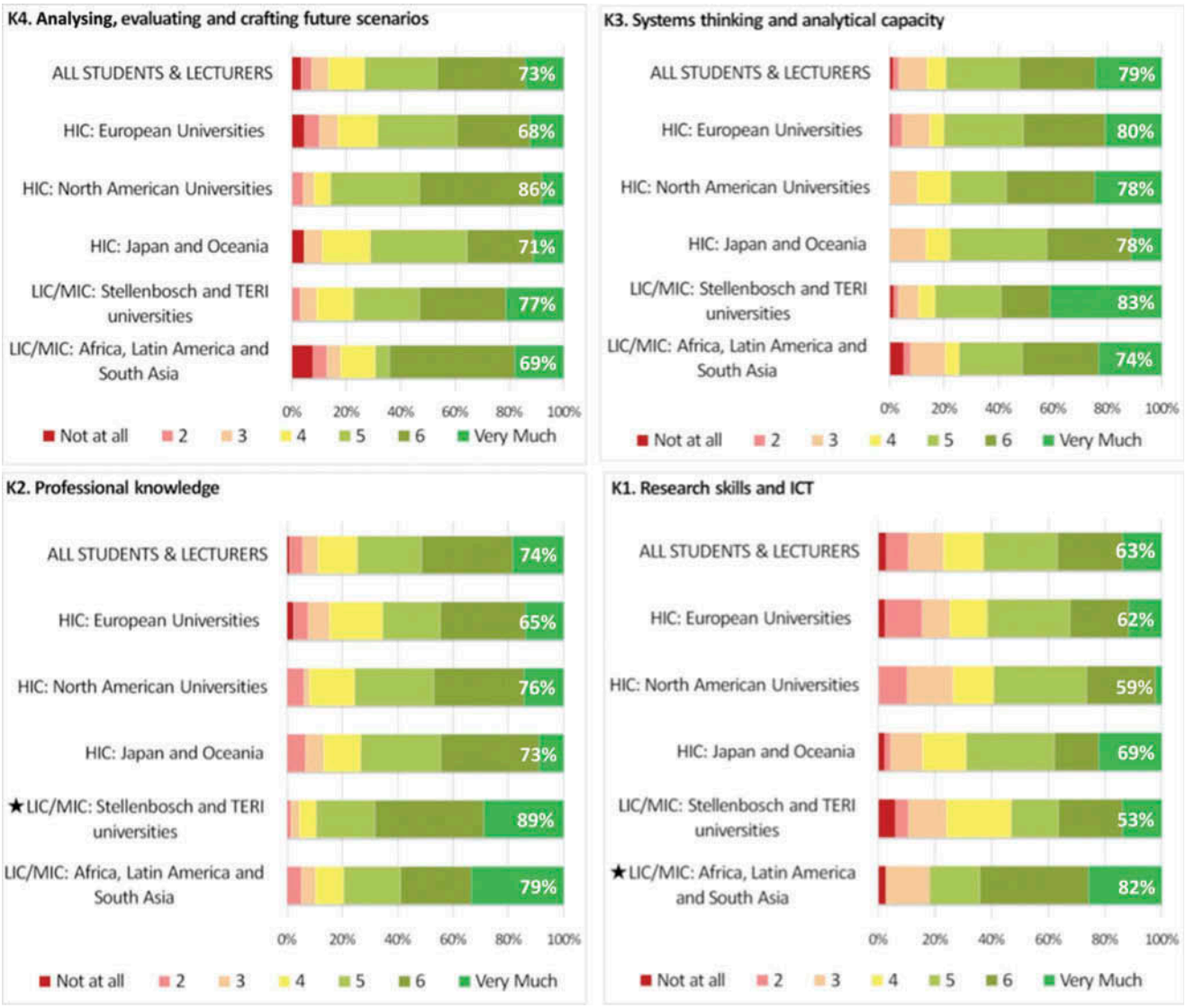

Figure 5. Extent to which 'Know' competencies are being taught in the five groups of programmes according to students and lecturers (n = 325). The percentages show the share of the three highest scales (5, 6 and 7 'very much').

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (Mann–Whitney U: $\alpha = 0.05$) (total students and lecturers, n = 325; HIC1, n = 128; HIC2, n = 48; HIC3, n = 44; LIC/MIC1, n = 66; LIC/MIC2, n = 39).

K2 'professional knowledge' (explained as 'professional knowledge of the natural and social science disciplines and of the relevant laws and regulations') scored relatively high with 74%. This competency scores notably higher in the lower-income countries' programmes than the higher-income countries' programmes. The more basic K1 'research skills and ICT' is the lowest scoring competency of the four in all geographic groups, except in the second lower-income countries' group. The score in these countries is significantly higher than elsewhere (82%).

4.5. *The 'Interact' cluster*

Compared to the 'Know' cluster, all of the 'Interact' competencies have a lower representation in the programmes. For this cluster, we see more variation between the various geographic regions. Three of the four 'Interact' competencies, I4 'leadership and social skills', I2 'using the media to bring a message across' and I1 'communicative skills', score notably lower in the European and the North American programmes than in Japan/Oceania and the LIC/MIC groups. On all four 'Interact' competencies, Europe has a significantly *lower* score than elsewhere.

The programmes in Japan and Oceania appear to spend considerably more attention to the 'Interact' competencies, all scores are significantly higher than elsewhere except the score I3 'strategic competency and practical skills', which is still higher than elsewhere. The scores of Stellenbosch and TERI are significantly higher for all

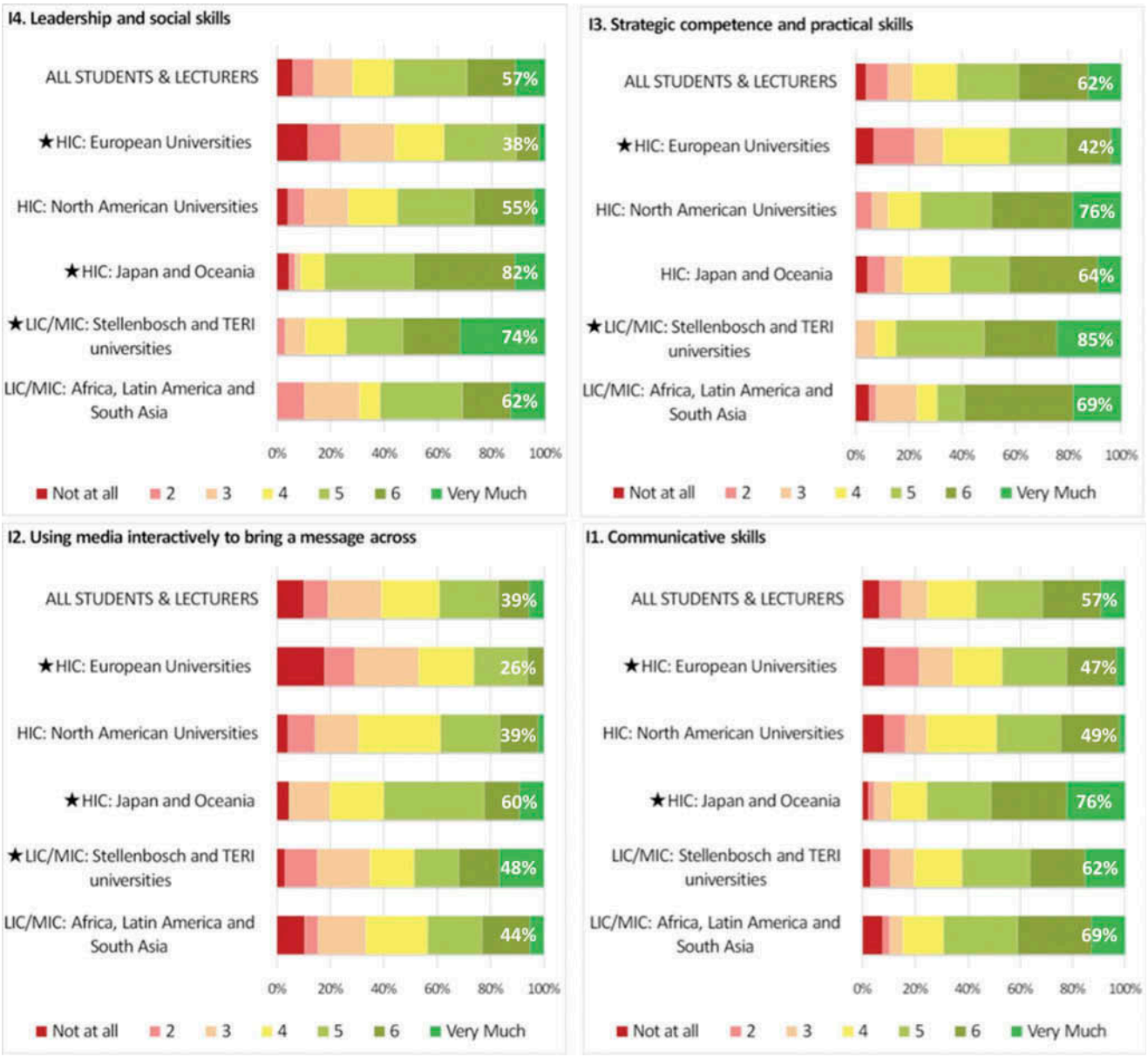

Figure 6. Extent to which the 'Interact' competencies are being taught in the five programme groups according to students and lecturers (n = 325). The percentages show the share of the three highest scales (5, 6 and 7 'very much').

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (Mann–Whitney U: $\alpha = 0.05$) (total students and lecturers, n = 325; HIC1, n = 128; HIC2, n = 48; HIC3, n = 44; LIC/MIC1, n = 66; LIC/MIC2, n = 39).

competencies except I1 'communicative skills', which also is still higher than elsewhere. The LIC/MIC2 programmes' scores are higher (but not significantly) than elsewhere on all competencies.

4.6. *The 'Be' cluster*

The three 'Be' competencies show a diverse result: the lower level competencies B1 'self-management and acting autonomously' and B2 'normative competency' are represented more often than the higher one. B3 'act as a SD example' is the second lowest represented competency of all (after I2 'using media interactively'). For competency B3, the differences between the groups are large. Europe's score is significantly lower and the score in North America is slightly lower than elsewhere, while this competency is significantly higher represented than others in Stellenbosch and TERI. In contrast, B3 'act as a SD example' is significantly more often taught in the lower-income countries' programmes and Japan/Oceania.

Attention to B2 'normative competency' is clearly less present in all high-income countries' teaching programmes than in the lower-income countries' programmes.

The lower-level competency B1 'self-management and acting autonomously' is the best represented in the 'Be' competencies cluster. Compared to the other geographic

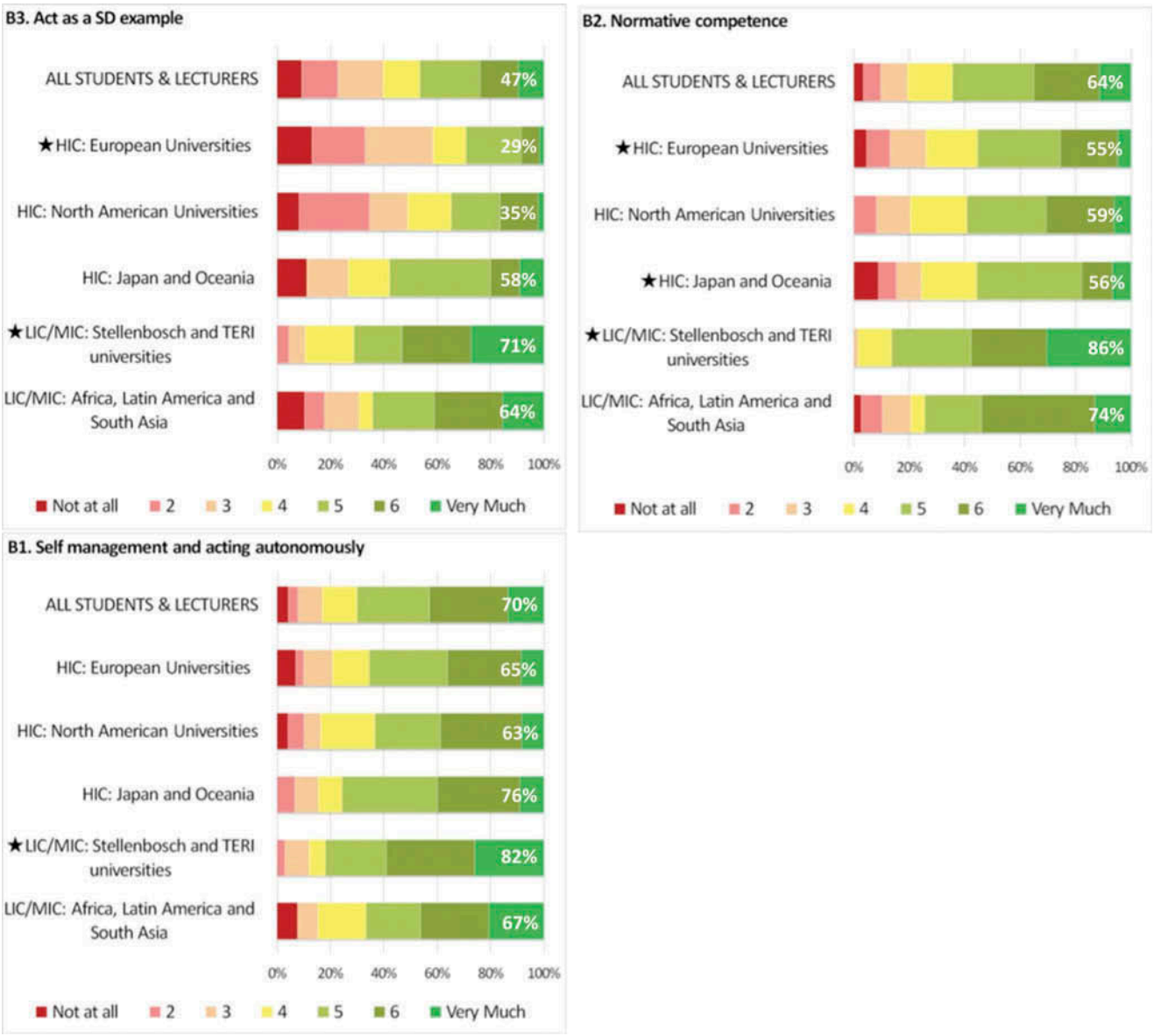

Figure 7. Extent to which the 'Be' competencies are being taught in the five programme groups according to students and lecturers (n = 325). The percentages show the share of the three highest scales (5, 6 and 7 'very much').

Notes: The ★ symbol indicates a significant difference between this group's (with the symbol in front) score and the 'all' group's score (Mann–Whitney U: $\alpha = 0.05$) (total students and lecturers, n = 325; HIC1, n = 128; HIC2, n = 48; HIC3, n = 44; LIC/MIC1, n = 66; LIC/MIC2, n = 39).

groups, the B1 competency is the least taught in Europe and North America followed by second lower-income countries. B1 is represented the best in the programmes of Stellenbosch and TERI, significantly higher than in others.

Finally, we asked to what extent the students and lecturers perceived each of these KIB competencies as important for sustainability professionals (see Figure 8).

The results resemble the attention given to these competencies in practice: in the 'Know' cluster, the strongest emphasis on K3 'systems thinking and professional knowledge'; in the 'Interact' cluster, the strongest emphasis on the I4 'leadership and social skills' and I3 'strategic competency and practical skills'; and in the 'Be' cluster, the strongest emphasis on B2 'normative competency'. However, Figures 5–8 also indicate that students and lecturers prefer a stronger emphasis on the 'Interact' and the 'Be' cluster competencies in the programmes.

The above results show at various points a difference between what is being taught in practice and what both students and lectures see as an ideal content and educational vision. In order to get a better understanding of these differences, as a final step in our survey to lecturers, a question was added on which factors determine the way their programme is being taught.

Interpreting these results in Figure 9, we see that what is being taught in sustainability master's programmes appears to be most highly influenced by the lecturer's

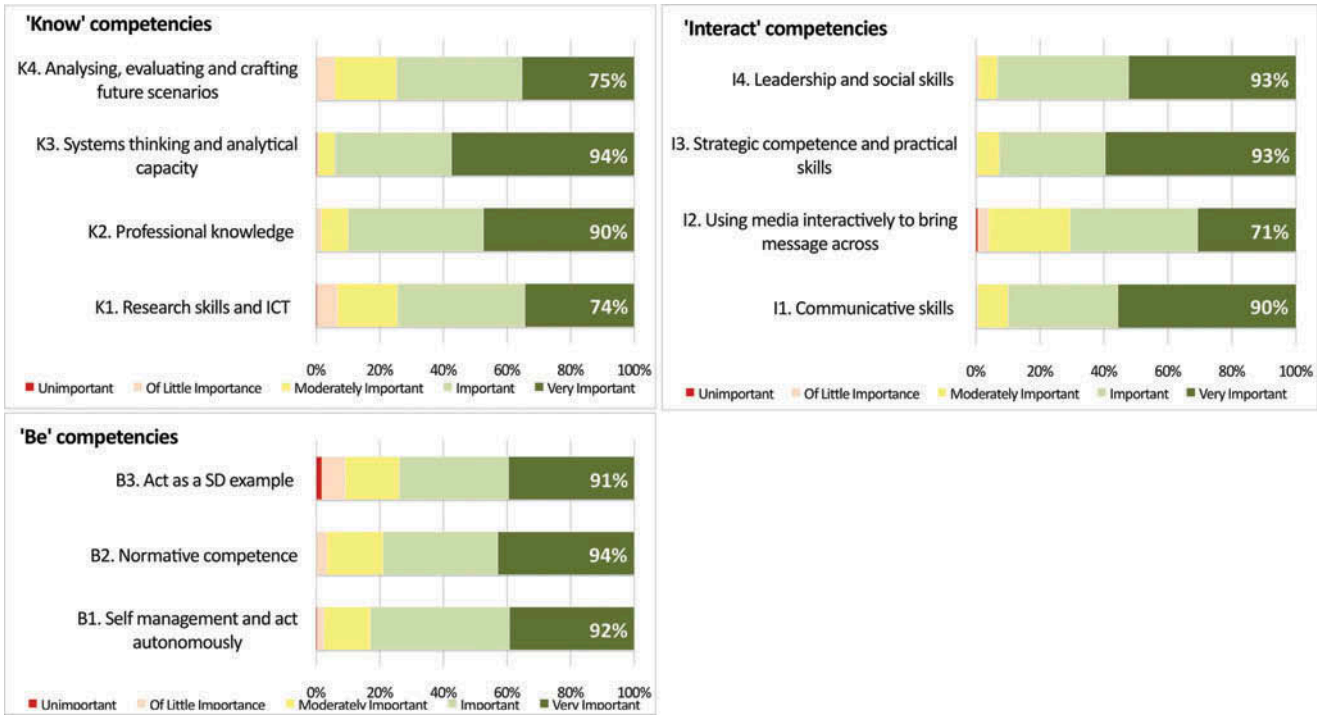

Figure 8. Perceptions of relative importance of various 'Know', 'Interact' and 'Be' competencies according to students and lecturers. The percentages show the share of the two highest scales (4 and 5, '(very) important'). (Total students and lecturers, n = 325; HIC1, n = 128; HIC2, n = 48; HIC3, n = 44; LIC/MIC1, n = 66; LIC/MIC2, n = 39.)

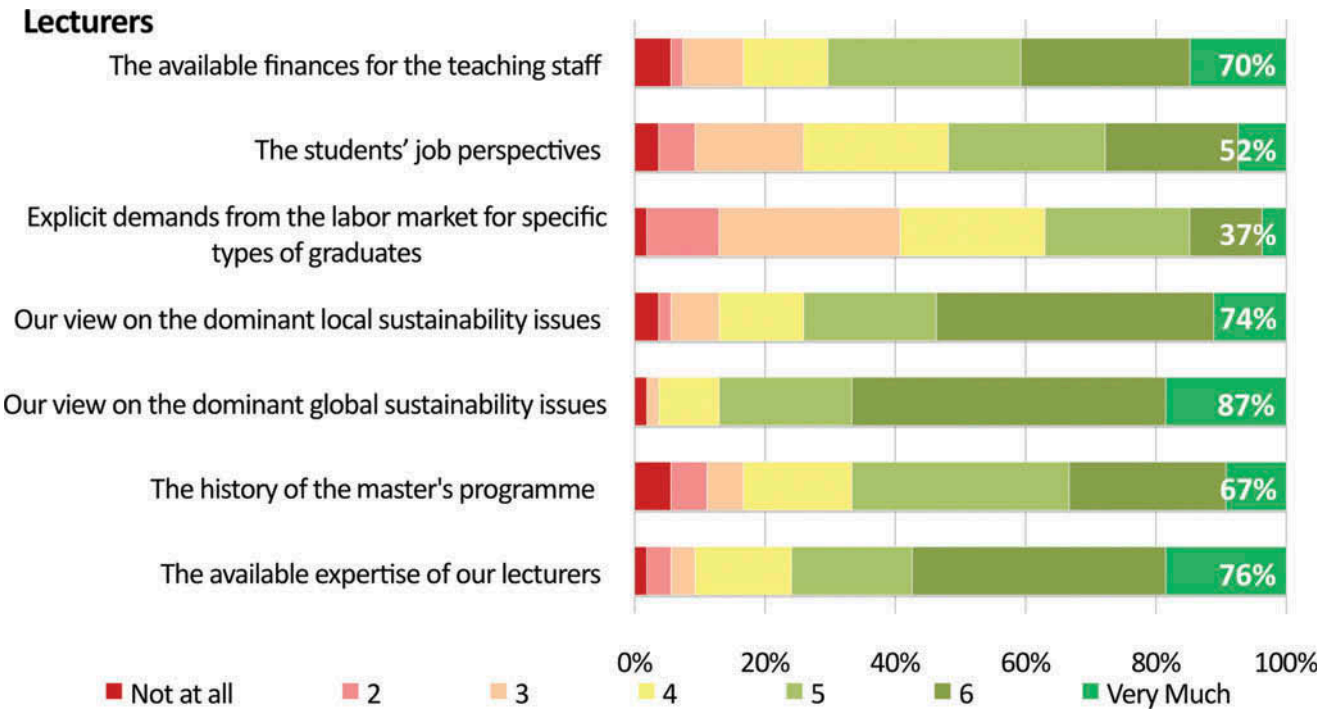

Figure 9. Lecturer response on five possible factors that could explain the way SD is being taught in the SD master's programmes (n = 54).

view on global and local sustainability issues, their available expertise and the available finances for teaching staff. This mix of factors includes few influences from outside the university. The students' job perspectives and demands from the labour market appear to play only a relatively small role.

5. Discussion and conclusions

This study was a first attempt to get a clearer picture of the practices around the world in academic master's programmes on SD. It addressed 34 programmes, some with a fairly long history, and others more recently established. As such, we were able to contact 341 students and lecturers at these programmes, a relatively high share of the 50 programmes identified by Van de Keere (2012). Monitoring what is happening in practice is very complicated, because programmes each contain various different courses, which each may have their pedagogy, but in combination would create the intended learning outcomes. It is impossible to look in great detail into each of those courses for so many programmes. Moreover, programmes change over time and new ones enter the scene, while others cease to exist. However, we believe we have been able to give a valid first glance at what is happening in practice.

In this article, we have posed a two-fold question about the ways in which SD is being taught in academic SD master's programmes (what and how?) and how this relates to the views in academic literature on which competencies SD students should develop to become future change agents. The analysis shows that in practice there are some gaps between preferences and practice. Looking at what both lecturers and students see as essential topics to address, we observe that some topics get relatively less attention (like the population issue).

As for the first part of the research question (what and how?), the results show that all *sustainability issues* are given at least some attention in all programmes, but the representation varies among the groups. *Population growth* is the least taught topic. *Ecosystems and biodiversity loss* and *inefficient production and consumption* are both reasonably represented in all programmes. *Poverty and food security* is given significantly less attention in the programmes in Europe and Japan and Oceania compared to the programmes in North America and the two LIC/MIC groups. *Energy and climate change* is very well represented in all programme groups. The only programmes in which *urban sprawl and unhealthy megacities* is a main theme are Stellenbosch and TERI. These variations may reflect different regional preferences and needs.

With respect to the 'how?' question, we have seen in literature a great debate about applying *interdisciplinary* and *transdisciplinary approaches* in contrast to more traditional *disciplinary* and *value-free empirical* approaches, while other scholars promote a more value-based *personal development* approach. This study shows that things are never as black or white as they seem. In practice, it is not a matter of exclusively choosing one or the other vision, but rather of finding the right balance. Looking at the results, we see very clearly that conventional teaching styles (subdisciplinarity and the value-free empirical vision) do not dominate sustainability master's programmes. The alarming observation by different scientists around the start of the twenty-first century, that the trend in higher education towards further specialisation together with traditional teaching styles does not produce the sufficient knowledge, skills and attitudes to produce graduates capable of accelerating change towards a sustainable future, is in practice already addressed with an adjusted mixed approach in academic SD teaching. The SD master's programmes that participated in this study definitely cannot be positioned under this 'mainstream trend towards specialization', not according to the dominant educational visions and not according to the preferred balance of educational visions. Moreover, none of the different geographical groups of programmes were dominated by 'conventional modes of education'.

The call for mode 2 ways of teaching sustainability development appears to be shared by the lecturers and students who participated in the survey; students are interested in being taught in a way that includes all educational visions, but appear to prefer a programme that is highly interdisciplinary and transdisciplinary, yet also includes elements of 'personal value development' and more traditional subdisciplinarity-based content of facts and theories. Lecturers in the field of SD teaching have established a teaching practice with far less emphasis on 'value-free empirical' vision as a main element of education and indicate that programmes should, apart from being interdisciplinarity and transdisciplinarity, focus more on personal value development and less on purely empirical knowledge (re-)production.

As for the second part of our research question about competencies, we have proposed a commonly applicable set of required competencies for academic sustainability professionals (in Table 1 as result of our literature review) and analysed to what extent these are addressed in practice and seen as relevant by students and lecturers in various programmes worldwide. The results show that the three clusters of *competencies* proposed were each strongly supported by lecturers and students. Our KIB framework helps to specify in more detail the call for more 'knowledge, skills and attitudes', which students should develop to accelerate change towards a sustainable future, as raised by Gibbons et al. (1994).

Reviewing the KIB framework, students appear to consider all competencies of the framework important for their later career as a change agent. The competencies considered most important by students for sustainability professionals are K3 'systems thinking and analytical-integrating capacity', K2 'professional knowledge', I4 'leadership and social skills', I3 'strategic competency and practical skills' and I1 'communicative skills'. Two competencies appear to be considered as the least important: I2 'using the media interactively to bring a message across' and B3 'act as Sustainability example'.

In practice the 'Know' cluster of competencies (K4-K1) appears to be the best-represented cluster of competencies compared to the other KIB clusters in the different master's programmes around the world. B1 'self-management and acting autonomously' is also well

represented in all groups, albeit the scores on this competency are slightly lower. The 'Interact' cluster received mixed scores, the competency that is represented the least in all groups of programmes is I2 'using the media interactively to bring a message across'. Luckily, this is also the competency that is considered the least important. An explanation could be that students and lecturers possibly only focus on the first part of the competency 'using the media' or may think that others will do the communication.

The call by Norbert-Hodge (2000), among others, that higher SD education should produce generalists who are able to look at sustainability issues from a range of disciplinary angles, cultural perspectives and spatial perspectives and different time spans appears to be well founded in the programmes studied here. The high level of interdisciplinarity and transdisciplinarity of the programmes, the diverse academic background of the students and the high representation of competencies like systems-thinking suggest that the conditions for producing such generalists are met in many programmes.

The representation of the 'Be' competencies, however, is remarkably low in the European and North American programmes (as are the 'Interact' competencies in European programmes). Should this be considered problematic? One may argue it should; in literature, these competencies are advocated as being important for future change agents, and students and lecturers also indicate that they consider these competencies important and would like them to be included in education. A possible explanation is that the expertise is just not there. The survey also showed that the way in which sustainability is taught is highly influenced by the available expertise of the academic lecturers (see Figure 9). These may just not be the ideal 'personal development' coaches to students. Here, we agree with Sherren (2005) that this does not need to be problematic, since no perfect 'one-fits-all' approach is desirable; each institution should rather build on its own strength. One might also question whether students should acquire all KIB competencies in their master's programmes. There are also other opportunities for learning these competencies. Could it be possible that European students already possess (or are considered to possess) competencies that they have learned in previous education? Competencies that students in other continents did not yet have the opportunity to learn? It would be wise for further studies to also take into account lower education levels in a study on what competencies SD students are being taught.

If we look at required competencies, it is remarkable that those competencies that are essential to be able to play a role as 'change agent', K4, I4 and B3 in the KIB framework, are undervalued both in practice and in the preferences stated by lecturers and scholars. Here, we see a gap between what front-running scholars in international literature promote and what is happening 'on the ground'. One might argue that the specific approaches for enabling the development of these 'top' competencies are not well known and developed. This would call for a more intensive sharing of 'best practices', which is partly done by the various publications in this field. However, existing global networks and platforms, like the International Sustainable Development Research Society, or COPERNICUS Alliance: European Network on Higher Education for Sustainable Development, could serve such a role.

However, as we already argued, no 'all-fits-one' template would be useful. Programmes do need to adjust to the specific problems and needs in their own region. It is wise for programme leaders to explicitly contextualise their programme. Programmes should preferably not be merely a reflection of the knowledge supply side at a university, but should respond to the needs around them. By engaging with regional stakeholders, alumni and their employers' programmes can very well identify the specific needs in the regional national markets (see Bootsma & Vermeulen 2011) and experiences in practice of their own alumni (Hansmann et al. 2012). Such stakeholder consultations in practice can serve as a first step to better embed programmes in regional/national networks and initiate closer collaboration in transdisciplinary projects (Bootsma et al. 2014). We believe that exposing students to such forms of collaborative engagement is one of the ways to allow students to develop the 'top' competencies. Here, SD education practitioners can help each other more by sharing best practices.

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