The interrelations between competences for sustainable development and research competences

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Abstract

Purpose – The overall purpose of this article is to explore how competences for sustainable development and research interrelate within a context of competence based higher education. Specific focus is oriented towards strengthening research competences for sustainability.

Design/methodology/approach – Following a hermeneutic-interpretive methodology, this article builds upon a critical literature review to demarcate the theoretical framework, and the in-depth analysis of a case study exploring the interrelations between both types of competences.

Findings – The article discusses current issues in the integration of competences, and explores the contribution of research based methods to acquire competences for sustainable development. The analysis shows that research skills are often mentioned to contribute to this acquisition, though from

a general perspective, or from the sidelines of the learning process. A holistic view on how both concepts are linked is missing.

Research limitations/implications – First, the complex nature of competences and their integration in higher education could lead to difficulties in interpreting and analysing them. Second, the analysis is based on a single case study, limiting possibilities to generalise results. Third, this study is not looking at curriculum practices in these fields.

Practical implications – There is a need to holistically (re-)frame research competences within the concept of education for sustainable development, and to a wider extent, sustainable development.

Social implications – Framing research competences within the concept of sustainable development enables a thorough and 'conscious', rather than coincidental, acquisition of competences for sustainable development.

Originality/value – The originality of this article lies in the fact that there is little literature about the interrelations between competences for sustainable development and research competences.

Key words

competences for sustainable development, education for sustainable development, information literacy, research competences, higher education

1. Introduction

Higher education (HE) has become increasingly competence-based, as a result of the rapid evolution influenced by social constructivism theory, and in an attempt to provide a better answer to the demands of the labor market (Van den Berg et al., 2006). Higher education institutions (HEIs) integrated competences, also referred to as competency (competencies), key competences, or a combination of knowledge, skills, attitudes and values. Over time numerous definitions of competence have been drafted, however an important basic characteristic is the mobilisation of both cognitive and non-cognitive aspects to meet complex demands in a particular context. The term key competence refers to those competences relevant for every person, in any context (Rychen and Salganik, 2003, see also section 3).

The aim of HE is to prepare students for their future role in society, whether this is their role as professional, policy maker or consumer. Society today is facing major challenges, often referred to as 'wicked' problems (Rieckmann, 2012, p 127, Wiek et al., 2011, p 203). This term relates to the complexity of issues of sustainable development (SD), and the interference of these issues at different levels (local-global), different timescales (past-present-future) and different geographic scales (north-south). As a response to these issues, key competences for SD were defined, based on values and ethics, and oriented towards systems thinking, anticipatory thinking, normative elements, strategic elements and interpersonal elements (Wiek et al., 2011, see also section 3). In an attempt

of higher education to respond to sustainability issues (e.g. Velazquez et al., 2005), and given the notion of competence-based HE with the aim to prepare students to respond to SD issues, the critical question raised by researchers in the field of higher education for sustainable development (HESD) is: do our students acquire these critical competences to face SD issues in society? (Rieckmann, 2012, Lambrechts et al., 2013, Lans et al., 2014).

The concepts of competence-based HE and competences for SD can be positioned within the framework of social constructivism, stating that learning in (higher) education is actively constructed by the learner and is, in essence, self-regulated, situated, collaborative and individually different (Van den Bergh et al., 2006). Looking at education for sustainable development (ESD) from the perspective of social constructivism, competences for SD could be seen as both the starting point to integrate SD in HE, and as the desired goal to be achieved by students.

Two specific areas in the field of competence-based education are addressed in this article: "competences for sustainable development" and "research competences". Competences for SD are defined, starting from the idea that the complexity of current and future societal problems cannot be addressed using classical education models, which focus on mere knowledge transfer (Wiek et al., 2011). Research competences are defined to enable students to analyse a given topic or subject in a structured, research-based way, often following the systematic steps in a research project (Verburgh, 2013).

This article explores the interrelations between competences for SD and research competences. Section 2 explains the research question, scope, method and limitations. Section 3 provides a theoretical framework, section 4 presents the case study in which interrelations between both competence concepts have been explored in Leuven University College (KHLeuven), a Belgian HEI. Section 5 provides the discussion on the interrelations between both competence concepts. Section 6 concludes this article and provides critical steps for further research.

2. Research question, scope, method and limitations of the research

The main research question addressed in this article is formulated as: "what is the relation between competences for SD and research competences?". The following sub questions are focused upon:

- What are the critical issues in the discourse and debate on defining and integrating competences for SD and research competences?
- How can research competences be positioned within a framework of SD, in order to contribute to the transition towards 'higher education for sustainable development (HESD)'?

A response to the research questions is based on a hermeneutic-interpretive phenomenology, aiming to explain the meaning of a given text or (social or cultural) phenomenon. This methodology is grounded in Heideggers' work (Heidegger, 1962), further developed by Gadamer (1976) and Ricoeur (1974). It is a form of interpretation, however without prescriptive factors, thus calling upon an iterative process including critical reflection. Given the complexity of the competence concept and the multitude of definitions and interpretations (as outlined in section 3), this approach provides a

framework for critical analysis. In a first step, a critical literature review demarcates the theoretical framework, with a focus on competence-based higher education, competences for SD and research competences. As a second step in the research process, the in-depth analysis of the case study further explores the interrelations, based on documentary analysis, analysis of competence matrices of different study programs, and focus groups reports in the university. The sources for this analysis are external and internal reports. The analysis of competences for SD within the 14 study programs of this HEI has been reported in an international peer reviewed article (Lambrechts et al., 2013) and international conference proceedings (Lambrechts et al., 2010). The analysis of research competences has been reported in a comprehensive internal report including the outcomes of four different focus groups, one in each of the four departments of the HEI (Vanhoren and Lambrechts, 2009). Each source has been interpreted and analysed in an iterative process focusing on the critical characteristics of (1) competences for SD; (2) research competences; (3) the interrelations of both concepts. The iterative process implies that after each step, new insights are added to the outcomes of previous steps and require a new interpretation of the results.

In order to validate the results of this approach, the outcomes have been presented, and discussed by two independent groups of stakeholders (researchers, teachers) at two international conferences: the International Conference of Environmental Management for Sustainable Universities (EMSU), Istanbul, Turkey, June 2013, and the International Conference Designing a Sustainable Future through School Community Collaboration (CoDeS), Barcelona, Spain, May 2014. The outcomes of both seminars confirmed the findings of the study, as reflected on in the conclusion section of this article.

The scope of the article is defined as follows: it starts at a general level, looking at competences and competence-based higher education. The article further narrows the topic down to 'general' competences for SD and 'general' research competences, that are applicable in a variety of study programs. It does not look at specific (or disciplinary) competences (e.g. research competences in science and engineering are different than the ones in humanities). Furthermore, the case study analysed is a university college, that has been selected because of its specific integration process of both competences for SD and research competences, and provides valuable materials to explore possible relationships between both concepts.

Limitations of the research could be identified at different levels. First, the complex nature of competences and their integration in higher education could lead to difficulties in interpreting and analysing them (these issues are dealt with in section 3). Second, the analysis is based on a single case study. However this approach is often seen as appropriate to analyse complex situations (Hoover and Harder, 2015), looking at only one case limits possibilities to generalise results (Barth, 2013). Third, the analysis looks at 'general' competences, thus competences one desires to integrate in every study program. This approach does not focus on curriculum practices in this field; a limitation that is dealt with in the discussion section as well.

3. Theoretical framework

The theoretical framework starts from the very broad perspective of competence-based higher education (section 3.1.), before further analysing the themes and topics of competences for SD (section 3.2.) and research competences (section 3.3.). To conclude the theoretical framework, section 3.4. explores the relationships between the two sets of competences before introducing the case study.

3.1. Competence-based higher education

Over recent years growing attention has been given to competence-based (higher) education (Stoof et al., 2002). Different theoretical, policy and practical frameworks have been developed and competences defined, translated and integrated into study programs. In an attempt to make HE more relevant towards the labor market, the focus was set on the acquisition of integrative competences rather than isolated (instrumental) skills and (disciplinary) knowledge (De Kraker et al., 2007). The integration of the competence concept in HE has led to extended debate about the definition of competences (Stoof et al., 2002). It seems that the discussion is leading to a broad consensus about the features of competence-based education: (1) the integration of knowledge, skills, attitudes and values, (2) learning based on projects, cases and problems, and (3) a stronger emphasis on independent learning (Rychen and Salganik, 2003, van Merriënboer et al., 2002).

Stoof et al. (2002) stress that there is no one definition of the competence concept, due to the lack of a theoretical framework. This discussion is further complicated because several meanings are being attributed to the competence concept in different sectors and contexts. Labor organisations interpreted competence in a different way to HE (Stoof et al., 2002). This is not necessarily problematic, as it is not unusual for a given concept to be defined and integrated in different contexts, but over the years the different meanings and interpretations were used interchangeably and the discussion became blurred. It is clear that the meaning of competence has become (too) elastic (De Kraker et al., 2007, van Merriënboer et al., 2002), which has consequences for the implementation of competences in education and the use of instruments for competence-based education. In order to tackle this conceptual problem, Stoof et al. (2002) propose a boundary approach to competence, allowing for a constructivist interpretation, by focusing on different inside-out dimensions and outside-in related terms.

Despite the conceptual problems, competence-based education is becoming widespread in different educational and professional settings, and for different reasons (De Kraker et al., 2007, Van den Bergh et al., 2006, van Merriënboer et al., 2002). First, the integration of competences could be oriented towards an innovation in education, in line with social constructivist theory and leading towards problem based education, the integrated approach of knowledge, skills, attitudes and values. Second, competences could be integrated in order to strengthen the relation between education and the labor market. A third reason why HEIs could integrate competences is mere "window dressing", because governments or accreditation bodies expect it. It is also possible that HEIs integrate competences for a combination of reasons.

The practical implementation of competences in existing educational systems also leads to extended debate. Stoof et al. (2007) report about conceptual, procedural, interpersonal and organisational problems when analysing the competence concept within the framework of curriculum design. Other authors mention the danger of making HE too instrumental, when competences are integrated with a strong focus on skills rather than a holistic approach of knowledge, skills, attitudes and values (see e.g. Hermans, 2007, Lambrechts et al. 2013, Mochizuki and Fadeeva, 2010), or simply when the competence concept is implemented inadequately (Lotz-Sisitka and Raven, 2009, cited in Mochizuki and Fadeeva, 2010).

3.2. Competences for sustainable development

In order to prepare students to cope with complex challenges, take action and contribute to sustainability in society, there is a need to integrate competences for SD, and rethink the mission of HEIs, their education, research, outreach and operations (Lozano et al., 2013). Opinions about how to do this range from a simple "add-on" to the existing curriculum to a complete transition towards sustainable education (Lambrechts et al., 2013). Sterling (2004) describes different levels of change, going from no or weak change, to a complete transformation. Cotton et al. (2009) point to the importance of so called "second-best solutions" for integrating SD within the current framework of HE. Other authors (Mochizuki and Fadeeva, 2010, Sleurs, 2008) point out that the integration of competences for SD into HE, could be a first stepping stone towards sustainable education and serve as a basis for change in curriculum and HE pedagogies.

Competences for SD exist in various forms, definitions, settings and interpretations. Several authors defined lists of competences (e.g. Barth et al., 2007, De Haan, 2006, Jucker, 2011, Roorda, 2010, Rieckmann, 2012, Wiek et al., 2011), offering a set of knowledge, skills, attitudes and values, necessary to ensure that graduate students are able to cope with the complexity and uncertainty of sustainability issues. Although using different methods to define and cluster the competences for SD, all sets cover comparable elements, as described by Wiek et al. (2011): systems-thinking competence, anticipatory competence, normative competence, strategic competence, interpersonal competence. Table 1 shows the definition of each key competence, as provided by Wiek et al. (2011).

Table 1. Definitions of key competences for SD (Source: based on Wiek et al. 2011, p. 207-211)

Name of key competence	Definition
Systems-thinking competence	'the ability to collectively analyse complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks'
Anticipatory competence	'the ability to collectively analyse, evaluate, and craft rich "pictures" of the future related to sustainability issues and sustainability problem-solving frameworks'
Normative competence	'the ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets'
Strategic competence	'the ability to collectively design and implement interventions, transitions, and transformative governance strategies towards sustainability'
Interpersonal competence	'the ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving'

The defined sets of key competences for SD provide a common and explicit framework to work on the integration of SD in HE, however they could be characterised by what Wiek et al. (2011, p. 204) call "laundry lists of competences", being too fragmented and missing the interlinking between competences. Furthermore, in addition to these key competences for SD, a disciplinary translation is needed to ensure these general competences are integrated in current study programs (Roorda, 2010). This translation has been made for several disciplines, e.g. for teacher training (Sleurs, 2008), social work (Peeters, 2012), marketing (De Cort and Lambrechts, 2014) and ecodesign in HE (Verhulst and Van Doorsselaer, 2015, in press).

The integration of competences for SD has been assessed within different settings and study programs, by analysing the competence schemes of study programs and/or policy documents (e.g. Cortés et al., 2010, Lambrechts et al. 2010, 2013, Segalàs et al., 2009). Taking the limitations of this type of analysis into account, mainly the fact that these studies are based on document reviews and not the actual practices within the curriculum (Lambrechts et al., 2013), they provide useful information about the current status of integration of key competences for SD in certain study programs.

Lambrechts et al. (2010) report on the integration of competences for SD in fourteen study programs in Leuven University College (KHLeuven). Based on this research, a comparable study was made for bachelor programs in management, reported by Lambrechts et al. (2013). The analysis in both studies pointed out that competences for SD are integrated in an implicit and fragmented way, and that there is a need to frame general competences within the concept of SD; implicitly referring to the presence of certain elements of sustainability within the competence schemes, but without describing them in an explicit way, e.g. critical thinking is prominent, without being explicitly linked

to SD issues. Fragmented integration refers to the presence of some elements of SD competences, without providing a coherent approach, e.g. interdisciplinary thinking is mentioned, without referring to systems-thinking competences. This results in a situation where competences for SD will not be integrated thoroughly into the curriculum, but in a rather "unconscious" or "unofficial" way (Lambrechts et al., 2013, p. 72), acquiring these competences for SD thus becomes a side-effect of the learning process.

The acquisition and assessment of competences for SD require different ways of teaching and learning which focus on experiential learning, reflective learning, participative learning, active learning, creativity, collaboration, problem solving, practice-based learning, transdisciplinary approach and self-regulation (Sterling 2004, Wals en Jickling 2002, Wals, 2010). This different way of teaching and learning is necessary for universities to contribute to a more sustainable society, because, as Wals (2010) states: "At present, most of our universities are still leading the way in advancing the kind of thinking, teaching, and research that accelerates unsustainability" (Wals, 2010, p. 387). In other words, business as usual is not an option for HEIs (Tilbury and Mulà, 2011). Within the analysis of competences for SD, Lambrechts et al. (2013) identified three main characteristics of teaching and learning methods: interactive and participative methods (e.g. Socrates method, group discussion, role play, group or personal diary, brainstorming, peer assessment); action oriented methods (e.g. learning through internships, solving real community problems, outdoor education) and research methods (e.g. bibliographic research, problem analysis, value clarification, case studies, concept mapping).

3.3. Research competences

Research competences are described in various ways, depending on the specific purpose or discipline in which they are used. HE integrates research competences for two reasons: (1) students acquire "instrumental" research skills ("doing research"), (2) students acquire a critical and reflective "research attitude". Generally, the description of research competences is focused on instrumental research skills, but other components also have to be considered within the concept of research competences. Verburgh (2013) describes six research-related learning outcomes which could be addressed in a given education profile:

- Results: Acquiring knowledge from results of research;
- Underpinnings: Gaining insight into methodological and theoretical underpinnings of research;
- Practical research skills: Developing particular practical research skills;
- Competence to be a researcher: Developing the competence to be a researcher;
- Critical thinking: Developing a critical attitude towards information, knowledge and knowledge construction; and
- Curiosity: Developing a curiosity towards evolutions in the discipline.

Over recent years, considerable attention has been paid towards the relationship between research and teaching, and the integration of research competences in HE (Verburgh et al., 2013). The

importance of integrating research competences is stressed, not only for academic bachelor and masters' programs, but also for secondary education (De Groof et al., 2012, Stokking and Van der Schaaf, 1999, Van Looy and Elias (ed.), 2007, Verburgh et al., 2013). The literature points out that there is a lot of discussion about the definition and formulation of research competences. Different definitions and frameworks were used in order to analyse the integration of research competences. It is clear that integrating research competences can focus on different goals and learning outcomes, depending on the context of education. These goals for the integration of research competences are presented in table 2. They can be oriented towards the acquisition of knowledge on a topic or on the act of doing research; the acquisition of specific research skills; learning how to learn; or attitude development (based on Stokking and Van der Schaaf, 1999, Verburgh, 2013).

Table 2. Goals to integrate research competences (Based on Stokking and Van der Schaaf, 1999; Verburgh, 2013)

Description of the goal	Characteristics	Final results
1. Students are doing research, in order to further develop their knowledge about a given subject	- inquiry-based learning	Acquire knowledge on a given topic
2. Students are doing research, to motivate them to actively examine a subject in depth and/or have them work and learn independently	- inquiry-based learning - linked with other competences (e.g. cooperation)	Learning how to learn
3. Students gain knowledge of what research is about: link between theory, research question, research design, data and conclusion	- learning how to do research	Acquire knowledge on doing research
4. Students gain experience in certain skills associated with research	- learning how to do research	Acquire specific research skills
5. Students become acquainted with the tools of a researcher	- learning how to do research	Acquire knowledge on doing research
6. Students become acquainted with the 'ethos' of research (e.g. critical attitude, curiosity, objectivity, etc.)	- learning how to do research - linked with general education	Attitude development
7. Students understand that knowledge is developed by people	- learning how to do research - linked with general education	Attitude development

3.4. Debate on competences for SD and research competences

The debate about key competences for SD is mainly focused on how these competences can be defined and integrated in HE curricula. Different perspectives about the relation between competences for SD and research competences can be identified within the discourse. On the one hand, all lists of key competences for SD contain elements relevant within a research context, however literature about key competences for SD makes little or no reference towards research

competences. On the other hand, research-based pedagogical methods are often seen as adequate ways to acquire competences for SD (Lambrechts et al., 2013).

Setting the focus of key competences for SD, based on reported overviews in peer-reviewed literature, and influenced by literature on sustainability science, Wiek et al. (2011) position five key competences for SD to converge towards a comprehensive key competence, the "sustainability research and problem-solving competence". This comprehensive key competence integration consists of: systems-thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence (see table 1). Furthermore, research is seen as a basic capacity, that, along with other basic capacities (e.g. critical thinking, communication) serve as a capability for ESD within HE, as the authors state "there is no doubt about the necessity of building these distinguished competencies in conjunction with "regular" or basic competencies conveyed in academic education" (Wiek et al., 2011, p. 211).

Brundiers et al. (2010) call for real-world learning opportunities to enable students to acquire key competences for SD. Three clusters of key competences are identified, the strategic knowledge cluster, comprising systemic, anticipatory, normative and action-oriented competence; the practical knowledge cluster, integrating competences necessary to link knowledge and action for SD; the collaborative cluster, involving collaborative and empathic competences. It is within this last cluster that "facilitating participatory research" is seen as an important aspect. Moreover, the authors state that real-world learning opportunities could enhance students' research skills. Also within a case study on lecturers' perspectives on education for sustainable development in HE reported by Cotton et al. (2009), one of the main constraints turned out to be the conflict with 'conventional' HE pedagogies. Interviewed lecturers had a clear preference for student-centered and interactive pedagogies over passive lectures. However, research-based methods did not appear in the results of this study (Cotton et al., 2009).

The debate on acquiring competences for SD is looking at the role of research competences and research-based methods from different angles. In some cases, key competences for SD should be based on general competences, such as research, critical thinking, communication (e.g. as reported by Wiek et al., 2011). In this view, it is assumed that a student has already acquired some necessary competences (whether or not to a certain level) in order to further acquire specific sustainability competences. Other perspectives state that the active and participative learning methods, applied in higher education in order to enable students to acquire competences for SD (such as real-world learning) help enhance students' research skills (e.g. as reported by Brundiers et al., 2010). In this view, focusing on competences for SD is seen as a way to contribute to the acquisition of research competences. Another perspective starts from the change in higher education, which is needed in order to implement competences for SD, i.e. practice-based learning, problem-based learning, collaborative learning (e.g. as reported by Wals, 2010). In this view, research-based learning and teaching methods contribute to the acquisition of competences for SD.

4. Case: exploring interrelations between competences for SD and research

KHLeuven is a middle sized HEI in Flanders, Belgium (approx. 8000 students in 2012), and offers professional bachelor programs in four departments: business studies, teacher training, social work, health care and technology. The HEI developed a model of general research competences, applicable in each study program, and made considerable efforts to integrate SD within its education (see section 3.2.), research, outreach (e.g. Verhulst and Lambrechts, 2015), assessment and reporting (e.g. Lambrechts and Ceulemans, 2013, Lambrechts, 2015), and campus operations (e.g. Lambrechts and Van Liedekerke, 2014). In 2014, KHLeuven merged with another Flemish university college (KHLim) to become University College Leuven-Limburg. This case however only focuses on the Leuven study programs. The research competences are described in section 4.1., and the analysis of possible interrelations with SD competences is presented in section 4.2.

4.1. Research competences at KHLeuven

Within KHLeuven, the debate about the integration of research into education evolved around two axes. The first axis is focused on introducing research competences in the curriculum, with the purpose to enable students to acquire them. This axis comprises instrumental skills ("learning how to do research") as competences oriented towards values and attitudes ("learning to act and reflect in a critical way"). The second is focused on making a practical and physical link between research and education, by means of introducing researchers to the curriculum (through lectures and courses), and by introducing students into research projects (by allowing them to participate in them). It is clear both axes correlate to each other and may strengthen each other.

With the purpose of integrating research in education, KHLeuven defined research competences applicable to all study programs. Most of the existing models are described and structured with a focus on instrumental skills, and/or they are defined on a general level, thus overlooking a lot of differentiated elements of values, attitudes and insights. It is clear that the definition and analysis of research competences suffers from the general competence-related problems that they are defined and interpreted in a rather instrumental way, narrowing down the focus to skills, and omitting values, attitudes and insights. Given these constraints, and in an effort to integrate competences in a value-based framework (Hermans, 2007), KHLeuven defined a set of research competences, comprising both instrumental skills and value-based attitudes. This set of research competences was drafted based on literature reviews of the integration of research in educational settings, and validated during a cycle of focus groups with representatives from each department (researchers, teachers, policy members) in which the research competences were discussed and described.

The competences are structured within the framework of a research process with different steps. The result is an integrated model of research competences, that takes into account the concept of competences, thus comprising knowledge, skills, attitudes and values. Table 3 gives an overview of the research competences as defined by KHLeuven within the case study (based on Vanhoren and Lambrechts, 2009). The competences follow ten systemic steps in a research approach, going from acquiring knowledge (step 1); formulating a research question (step 2); defining a research plan (step

3); collecting information and data (step 4); determining relevance of information and data (step 5); processing data (step 6); drawing conclusions (step 7); evaluating the research process (step 8); determining your own position and opinion (step 9); and reporting and presenting results (step 10). Each step is defined as a competence, further described in three to six subcompetences. Competences focused on acquiring research related attitudes are marked with the symbol (†). Competences related to information literacy are marked in this table with the symbol (*).

The framework was used to make an empirical, qualitative analysis of the extent of integration of these research related competences within each of the fourteen study programs of KHLeuven. For this reason, the competence matrices of each study program were analysed in order to discover where and to what extend research competences were already included within the study programs' intended curriculum. The analysis pointed out that research competences are integrated in the different study programs both in explicit and implicit forms. Explicit elements are often focused on particular aspects of instrumental research skills, however only integrating aspects partially and fragmented, e.g. refer to data analysis, but not mentioning reporting. Implicit elements might refer more towards acquiring a research based attitude, e.g. critical reflection when performing a particular task, without acquiring instrumental research competences. All bachelor programs integrate a combination of instrumental research skills and competences focused on acquiring a research based attitude. Both types are present to a greater or lesser degree, depending on the study program. Within the 'hard' Sciences (e.g. chemistry, biomedical laboratory sciences) more attention is given to instrumental research skills (data analysis), while in the 'human' Sciences (e.g. teacher training, business studies) acquisition of a research based attitude is considered more important (Vanhoren and Lambrechts, 2009).

Table 3. Research competences at KHLeuven (based on Vanhoren and Lambrechts, 2009)

Competence I. Acquiring disciplinary knowledge in a multi-, inter-, and transdisciplinary framework
I.1. Use disciplinary and professional concepts
I.2. Develop a curiosity concerning developments within the discipline (†)
I.3. Acquire knowledge and insights in the scope and results of research
I.4. Understanding the methodological approach of research regarding the own discipline
I.5. Read and understand relevant Dutch and international (English or other foreign language) research literature
I.6. Be able to interpret the developments within the own discipline in a multi-, inter-and transdisciplinary framework
Competence II. Formulating a research question
II.1. Recognize, orient and formulate a problem
II.2. Differentiate and formulate research questions, hypotheses and expectations
II.3. Formulating objectives and establishing links between already acquired knowledge and research questions, hypotheses and expectations (†)
II.4. Mapping of the various direct and indirect stakeholders
Competence III. Defining a research plan
III.1. Making a research design with (sub-)activities necessary to find an answer to the research questions
III.2. Define a realistic plan of action
III.3. Define a communication plan addressed to the various direct and indirect stakeholders
III.4. Follow-up of the planning and revise if necessary (†)
III.5. Work in an effective way and respect deadlines (†)
Competence IV. Collect, select and organise information, data and suitable source material *
IV.1. Identifying information needs, the type and scope of the necessary information *
IV.2. Be familiar with the variety of (scientific) (primary and secondary) sources of information and of the various methodical possibilities to gather these resources * (†)
IV.3. Select relevant information sources *
IV.4. Efficient data collection and relevant information, be familiar with databases for searching information, be able to find relevant literature *
Competence V. Determine the relevance, value, usefulness and representativeness of the obtained information, data and data sources, and using them correctly
V.1. Develop a critical attitude towards information, knowledge and knowledge construction * (†)
V.2. Be aware of the importance of reliable scientific information *
V.3. Critically evaluate and effectively, correctly and appropriately use the collected or generated information, regardless of the medium *
V.4. Handle sources in an integer way (†)
Competence VI. Processing data
VI.1. Be able to select appropriate methods and techniques for the processing of data
VI.2. Analyse data
VI.3. Interpret date
Competence VII. Drawing reasoned and argued conclusions
VII.1. Using new or original information in order to construct new concepts and insights * (†)
VII.2. Formulate conclusions
VII.3. Formulate recommendations
Competence VIII. Evaluate and assess the research
VIII.1. Be prepared to question each act or choice in the research process, both content related and methodological (†)
VIII.2. Critically evaluate the search for information *, the processing of data and formulation of conclusions (†)
VIII.3. Critical reflection on the quality of the performed research, of the own work and of the learning experiences (†)
VIII.4. Reflect on the analysis and judgment of complex issues taking into account social, scientific and ethical aspects (†)
Competence IX. Determine and argue a (own) position or opinion
IX.1. Use of information and research data taking into account cultural, ethical, economic, social and ecological standards and values * (†)
IX.2. Listen to and respect the opinions of others (†)
IX.3. Determine a reasoned own point of view, both in relation to the topic of research as the research process itself (†)
Competence X. Systematically report about (describe) and present (transfer)
X.1. (Interim) oral and/or written reporting to stakeholders
X.2. Proper use of references *
X.3. Presenting research results in a clear and logical structure, including correct (Dutch) language use

4.2. Interrelations between SD and research competences

Looking at the case described in this article from the perspective of key competences for SD, the framework of research competences of KHLeuven shows several SD-related elements. These are shown in table 4, depicting the possible contribution of research competences to those for SD. In their present description, the instrumental research skills could hardly be connected to those required for SD. Only three competences provide elements which could be related to competences for SD, mainly interpersonal competences oriented towards mapping of and communication to various stakeholders (II.4. and III.3.). Furthermore, the reference towards multi-, inter- and transdisciplinarity (I.6.) provides opportunities to relate to systems thinking competence.

It is clear that the focus of research competences on acquiring attitudes could contribute considerably to the acquisition of certain competences for SD, mainly related to the normative competence, interpersonal competence and strategic competence. This is exemplified by competence VIII, which is focused on evaluating and assessing the research process and outcomes, and provides several possibilities to link with those for SD. However, there is no explicit reference made towards SD. In order to actually contribute to competences for SD, these research competences should be framed and positioned within the concept of SD. Without this, the contribution to acquire SD competences will be minimal. Furthermore, the results show a clear lack of attention towards anticipatory competence and systems-thinking competences, as these could hardly be identified within the research competence framework. These results are also in line with previous analysis regarding competences for SD (Lambrechts et al., 2013).

Specific attention has been paid to the integration of competences related to information literacy within the KHLeuven framework. However often seen as a separate set of competences within higher education (e.g. Johnston and Webber, 2003), these competences are seldom focused upon from the perspective of SD. Within the KHLeuven framework, several elements of information literacy could be linked with elements of key competences for SD, as shown in table 4 (competences marked by (*)). These are mainly oriented towards developing a critical attitude regarding information, the research process and results, as well as being aware of the own perspective and the perspective of others.

Table 4. Elements of key competences for SD in the framework of research competences at KHLeuven

Relation with key competences for SD / Research competence		Systems thinking competence	Anticipatory competence	Normative competence	Strategic competence	Interpersonal competence
'Instrumental' research skills	**Competence I. Acquiring disciplinary knowledge in a multi-, inter-, and transdisciplinary framework**					
	I.6. Be able to interpret the developments within the own discipline in a multi-, inter-and transdisciplinary framework	✓				
	Competence II. Formulating a research question					
	II.4. Mapping of the various direct and indirect stakeholders					✓
	Competence III. Defining a research plan					
	III.3. Define a communication plan addressed to the various direct and indirect stakeholders					✓
Research related 'attitudes'	**Competence V. Determine the relevance, value, usefulness and representativeness of the obtained information, data and data sources, and using them correctly**					
	V.1. Develop a critical attitude towards information, knowledge and knowledge construction * (†)				✓	
	Competence VIII. Evaluate and assess the research					
	VIII.1. Be prepared to question each act or choice in the research process, both content related and methodological (†)			✓		
	VIII.2. Critically evaluate the search for information *, the processing of data and formulation of conclusions (†)				✓	
	VIII.3. Critical reflection on the quality of the performed research, of the own work and of the learning experiences (†)				✓	
	VIII.4. Reflect on the analysis and judgment of complex issues taking into account social, scientific and ethical aspects (†)			✓		
	Competence IX. Determine and argue a (own) position or opinion					
	IX.1. Use of information and research data taking into account cultural, ethical, economic, social, ethical and ecological standards and values * (†)			✓		
	IX.2. Listen to and respect the opinions of others (†)					✓
	IX.3. Determine a reasoned own point of view, both in relation to the topic of research as the research process itself (†)					✓

5. Discussion

This article started with the debate about key competences for SD, their definition and the implications of integrating them into HE. Traditional teaching methods, based on passive lecturing and focused on transmission of knowledge, might lead to more unsustainable societies (Wals, 2010), and are insufficient to acquire key competences for SD. The literature shows a clear preference towards active, student-centered and real-world learning methods. Research-based methods are also mentioned, mainly as a way to support other learning methods, and not as a proper method to acquire competences for SD.

Giving the complexity of SD issues, it is useful to analyse the role and contribution of research competences. This article has analysed the definition and integration of research competences within KHLeuven. Since this HEI did pay considerable attention to analyse both competences for SD and research competences, information about both was available for all of its study programs. The case pointed out that (instrumental) research competences are necessary in order to contribute to handling SD issues, while competences oriented towards attitudes are contributing to the acquisition of values and attitudes inherent to SD. However, there is a need to (re-)frame the research competences within the concept of SD, in order to truly contribute to the acquisition of those competences.

5.1. The problematic competence concept

The general attention towards competence-based HE is leading to extended debate about the characteristics of such education and about the practical implications when integrating this into existing study programs, as reflected in section 3. First, the competence concept has become too elastic and too blurry, due to mixed interpretations and expectations. Second, and as a result of this, competences are integrated in an inappropriate way into existing study programs, often leading to a mix of using competences in the 'old' system of courses and modules, and resulting in weak or wrong outcomes. The focus on one examination focused of knowledge acquisition, rather than developing the holistic approach of competences, is just one example. Third, competences are criticised because of the 'instrumental' translation made by HE policy and lecturers: competences should be defined in a way that allows them to be assessed, often leading to skill acquisition and omitting values and attitudes, as these are hard to assess. Within the case of KHLeuven, particular attention has been given towards framing the competences within general values. However, the analysis of the different study programs pointed out that the practical integration of the competences was often focused on instrumental skills rather than attitudes and values.

Key competences for SD suffers from the same symptoms of being too elastic, too blurry, integrated inappropriately, and focused towards mere instrumental skills. As these competences have a strong focus on complexity, interconnectedness, attitudes and values, it is particularly hard to deal with them in the current competence-based educational context. In recent years, many sets and frameworks of key competences for SD were defined, however their integration is still too fragmented, implicit, or focused towards instrumental skills, and the specific outcomes of these

competences are hard to measure (Lambrechts et al., 2013). Also within the case of KHLeuven, it seems there is a mismatch between the study programs' intentions (framing competences in values) and the practical situation, where the focus is pointed towards instrumental skills rather than integrative competences, and without any framing of the competences within the concept of SD.

5.2. Research competences for SD

In the literature, (instrumental) research skills and research-based pedagogical methods are mentioned as a way to acquire competences for SD (Brundiers et al., 2010, Cotton et al., 2010, Wiek et al., 2011). However, there is no specific focus on how these research competences could contribute to the acquisition of key SD competences, or the specific implications of this argument for HE. The case of KHLeuven indeed shows that, within the research competences framework, there are a lot of competences available which could theoretically contribute to acquire competences for SD, however without explicitly framing these competences within the SD concept, and making the link with competences for SD, their contribution will rather be a side-effect of the learning process.

Considerable attention has been paid to research competences and their integration in HE, independently from the concept of SD and related competences (Verburgh, 2013). Within the 'integration of research and education', the debate focused on two aspects: to help students acquire (instrumental) research competences on the one hand and to better translate research results into education on the other. However, the integration of research competences is too fragmented, too implicit, and too focused towards acquiring and assessing instrumental skills. Also within the case of KHLeuven, the research competences are integrated in a fragmented way, and not as a result of a planned and structured implementation process. This is symptomatic for the concept of competence-based higher education and also refers to the many conceptual and practical problems of competences (Stoof et al., 2005). There is a lack of systemic integration, based on a clear vision and holistic approach of the competence concept.

Research competences and research-based learning methods could contribute to the acquisition of key competences for SD, if two basic conditions are taken into account. The first condition is to define research competences within the framework of SD, e.g. by focusing on interdisciplinary (collaboration between different academic disciplines, each with their own specific profile and methods) and transdisciplinary approaches (collaboration between academia and non-academic partners, e.g. business, non-governmental organisations, etc.), stakeholder involvement, systems-thinking approach and anticipatory thinking. Instrumental research skills can indeed contribute to acquiring competences for SD, but there is a need to frame these within the concept of SD. The second condition calls for particular attention towards values and attitude development, more specifically the ethical perspectives inherent to SD. Therefore, a normative reflection on 'what is research' and 'what is the purpose of research' is needed. A lot of elements are already introduced in HE curricula, e.g. critical reflection, however they are not framed within, or connected to the SD concept.

The same applies for information literacy, which also needs to be (re-)framed within the concept of SD, as sustainability issues are characterised by complexity, multiple information sources, contradictory information, and changing information over time. The Leuven case pointed to several very concrete possibilities to link competences for SD and competences related to information literacy, more specifically in pursuing a critical attitude towards information specifically in a context which is characterised by complexity, uncertainty, and changing validity of information over time.

6. Conclusion

In an attempt to explore the interrelations between competences for SD and research, this article touched upon several issues regarding (1) competence-based higher education; (2) competences for SD; (3) research competences. The analysis of the study pointed out that the insights from theory could be identified within the case. The results and conclusions of this research have been presented and discussed at the International Conference of Environmental Management for Sustainable Universities (EMSU), Istanbul, Turkey, June 2013, and the International Conference Designing a Sustainable Future through School Community Collaboration (CoDeS), Barcelona, Spain, May 2014. The discussion with the external stakeholders in both seminars, confirmed that the main findings of the study could be identified in other HEIs as well. Three main conclusions that can be drawn from the analysis, were validated during these seminars, all focusing on the holistic approach of competences.

First, the multiple conceptual, procedural, interpersonal and organizational problems connected to competences (as described by Stoof et al., 2007) have led to a number of symptoms in the debate and practice. Although a general acceptance has been reached in theory, i.e. competences comprise knowledge, skills, attitudes and values (Rychen and Salganik, 2003), such an integrated view is missing when competences are implemented into higher education. Hence, there's a need to stress the holistic approach of competences, in order to surpass the level of instrumental skill acquisition and to encourage an adequate implementation in HE.

Second, it seems that competences for SD suffer from the same symptoms as the general competence concept. Although they strive towards the integration of knowledge, skills, attitudes and values, necessary to enable students to respond to sustainability issues (Wiek et al., 2011), HEIs are far from integrating these competences in a structured and systemic manner. Although a number of core- or key competences have been drafted, there is still a need for a holistic framing of these competences within the concept of sustainable development. Considerable attention is needs to be paid to the values inherent to SD.

Third, the analysis regarding research competences pointed towards the different possibilities, ranging from the acquisition of instrumental skills to the attitude of a researcher (Verburgh et al., 2013), to the acquisition of 'sustainability research and problem-solving competence' as proposed by Wiek et al. (2011). The case also pointed out that there is a need to reframe information literacy issues within the concept of SD, in order to enable students to cope with different information sources in a complex and uncertain context of sustainability issues. Despite the effort to define

integrated frameworks for research competences, their integration within study programs remains fragmented and too focused on instrumental research skills. Again, this calls for a holistic interpretation of research competences, first within the general competence concept, second within the concept of SD. Only by (re-)framing these research competences within SD, in an integrative and holistic way, will students be able to acquire the competences necessary to deal with the complexity and uncertainty of sustainability issues in society.

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