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Universities as change agents for sustainability – framing the role of knowledge transfer and generation in regional development processes

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ABSTRACT

This paper explores opportunities for universities to contribute to local and regional development processes, apart from classical knowledge transfer within education and lifelong learning. In order to draft an analytical framework for the university-society relationship in regional development processes, we introduce three theoretical frameworks: planning, learning, and implementation theory, as well as shift the research perspective from university to regional development processes. The elaborated framework is applied to two case studies in Austria: the Montagsakademie, an initiative of the Karl-Franzens University in Graz, and PlanVision, an energy research project between the University of Natural Resources and Life Sciences Vienna and the Town of Freistadt. From the analysis can be concluded that knowledge provision is not enough to establish the university as a change agent. In order to reach this effect, "ownership" of knowledge within local and regional communities has to be achieved. This ownership affects the level of values (shared visions and objectives concerning sustainable development) and the level of facts (addressing the skills for implementation and action) and can best be attained through joint knowledge generation. Universities that want to act as change agents have to thoroughly consider collaborative ways of research and education in informal learning environments so that knowledge demand, knowledge transfer and knowledge generation can be negotiated and jointly determined between local and regional societies and universities.

1. Introduction

At the end of the 1980s, the Brundtland Report "Our Common Future" (WCED, 1987) introduced the concept of *sustainability* into local, regional, national and global development processes. Striving for balanced social, ecological and economic development, the concept of sustainability offers a productive encounter with complexity, to the extent that it neither denies this complexity nor reduces it in an unacceptable manner (Adomssent et al., 2007). The concept of sustainability launches several new principles: (a) increasing significance of the local and regional level ("think global, act local"); (b) public and stakeholder participation; and (c) integrative, holistic approaches to regional and local challenges. To implement these principles in regional development (RD) processes the action programme "Local Agenda 21" (LA 21) was brought into being. The sustainability concept enlarged the "traditional" means in RD (such as financial incentives) with several others, including technology transfer, education, public awareness raising, training, information for decision making etc. (Section IV "Means of Implementation" of the Agenda 21 declaration). This shift in the orientation of RD processes towards sustainability, among other things, changes the perception of Higher Education Institutions (HEIs) within RD: from their "traditional" roles as mere educational infrastructure and research institutions, to "new" roles as drivers for innovation and stakeholders in public and private partnerships as well as in planning processes (Chatterton and Goddard, 2000).

This change of expectations around the role of HEIs in RD is influenced by supra-national European Policy: the European Union aims to establish a competitive, knowledge-based and innovative European region; at the same time the sustainability of this development has to be assured (KOM, 2001). Within these policy frameworks (Lisbon Agenda, Gotheburg Strategy, European, 2020 strategy), RD processes striving for sustainability focus on the following aspects relevant to HEIs:

- empowerment of the local population through education and lifelong learning (ÖROK, 2002);

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- wide access to education and qualification opportunities (ÖROK, 2002);
- incorporation of information and communication technology to overcome spatial barriers (Schnell and Held, 2005); and
- revaluation of educational institutions as providers of knowledge and as incubators for learning and innovation processes (Schnell and Held, 2005; Streich, 2005).

On the basis of two Austrian case studies, the present paper elaborates different ways, how HEIs (especially universities) can be integrated in sustainable RD processes. Furthermore, potential benefits and challenges of the university–region interaction are identified. This raises the questions: (1) How can universities contribute to RD processes? (2) Is the label "change agent" in the context of sustainable RD processes appropriate?

We do not consider "regular" academic education, although building up human capital might be an important factor for knowledge provision for RD (c.f. Maier and Toedtling, 2006; Florax, 1992; Uyarra, 2010). In our understanding "regular" academic education addresses incremental effects that – analogously to Strategic Environmental Assessment (SEA) theory (c.f. Bina, 2008; Jay et al., 2007; Stoeglehner, 2010) – may include (a) building up of governance capacity for sustainable development; (b) changing awareness for sustainable development; (c) supporting institutional change; and (d) establishing arenas for social learning. "Regular" academic education is how key stakeholders, including planners, consultants and decision-makers are often educated. Diffusion of frontier knowledge may face long delays if graduates do not regularly involve themselves in lifelong learning activities. Knowledge proliferation in the region depends very much on the positions the graduates occupy in the region and in the respective RD processes. Change induced by academic education works long-term if the duration of attending an academic programme is compared to the time-span of a professional career. Lifelong learning, as opposed to "regular" academic learning might offer the possibility of faster infiltration of "practice" with the latest research findings but depends heavily on the capacity and willingness of relevant actors to take part. Experiences show that this capacity is limited (Stoeglehner et al., 2006).

As the definition of "RD" is context specific, we develop our ideas from an environmental planning perspective, having three arenas for sustainable RD in Austria in mind: (1) the European Union LEADER programme (EG, 2006); (2) the LA21 programme (United Nations, 1992); and (3) spatial planning that strives for holistic spatial development including all dimensions of sustainability and leads to legally binding plans and programmes (Weber, 1996).

LEADER was established in 1991 as part of the European Union rural development policy in order to boost development potentials of rural areas. Thus, LEADER is more a framework then a set of measures, providing an opportunity to adapt the content of the processes to regional requirements. The first LA21 programme in Austria started in 1998. LA21 comprises actions necessary to implement sustainable development in all spheres of life and livelihood involving ecological, economic, social and cultural issues (Stoeglehner and Fischer, 2005). Both programmes aim to improve and secure quality of life as well as to establish and improve local and regional identity (Seher and Jungmeier, 2008). Both programmes take a bottom up approach, involving the interested and affected public, interest groups, regional stakeholders and political decision-makers through participation (EG, 2006; Seher and Jungmeier, 2008; ExpertInnengruppe LA21, 2010).

Further arenas for sustainable (regional) development may include urban and regional planning processes, that have a top down character as finally legally binding results arise, but are still supported by bottom-up elements and processes. Bottom-up components aim to involve the local/regional population in order to collect ideas about future developments, extract the value base and expectations about quality of life, and to gain awareness and understanding for the outcomes – visions and measures – of planning processes and their implementation.

In order to elaborate on the role of universities as change agents in sustainable RD, we take the perspective of RD processes and their needs for knowledge and information. As these kinds of RD processes can be understood as planning processes, we derive our analytical framework from theories related to planning, including planning theory, learning theory and implementation theory (see also Section 3). In the next section we build upon the recent debate on the role of universities in sustainable RD. Then we frame the university–society relation in RD processes, introduce and discuss two Austrian case studies for university action in rural regions and draw conclusions about if and how universities can act as change agents for sustainable RD.

2. Universities and sustainable RD – recent debate

Universities as objects of research in the context of RD have attracted attention since the 1950s in Central Europe. Before reflecting on the role of universities in *sustainable* RD processes, a synopsis of their general role within RD processes from various professional perspectives is provided, taking into account the impacts that universities have on RD via their core teaching and research activities:

- *Regional Economy* interprets universities as "soft" location factors, setting incentives for innovation, know how transfer, and supporting human capital to enhance RD and competitiveness (Florax, 1992; Fritsch and Slavtchev, 2005);
- *Educational Sciences* emphasize the reduction of spatial and social disparities in access to educational opportunities as well as the strengthening of regional labour markets by triggering spatial redistribution processes of mobile "production factors" (Gensch, 1980; Schelepa and Wetzel, 2009);
- *(Education) Geography* focuses on site identification for tertiary educational infrastructure as well as mobility processes of students, graduates and teaching staff in order to incorporate the *spatial* dimension into research about universities, which has so far been neglected by education policy and regional economy (Wagner, 1993; Meusburger, 1998);
- *Regional Science* and *Regional Planning* survey effects of universities on the standard of supply (concerning socio-cultural aspects) as well as effects on the attractiveness of residential locations and quality of life (Frey and Brugger, 1984; Pfähler, 1997).

The concept of *sustainability* inspired various scientific investigations about (1) integrating sustainability *in* university management practices (Lozano, 2006; Arbo and Bennworth, 2007), teaching (Cortese, 2003) and research (Waas et al., 2010; Adomssent and Michelsen, 2006); and (2) applying it as an overall concept for universities (e.g. the "sustainable university" (Adomssent et al., 2007; Velazquez et al., 2006)). Furthermore, high demand for research about universities as actors *within* sustainable development processes of communities and regions is noted. The latter forms the focal point of this paper.

Similar to RD, sustainable development is subject to different interpretations, which influence the viewpoints of university action in RD. From an economic perspective, sustainable development can be envisaged as maintenance and accumulation of different types of capital. Apart from production and social capital the most notable

impact of universities is the provision of human and intellectual capital (Lehmann et al., 2009; Moulaert and Sekia, 2003). These impacts of HEIs on sustainable RD are mainly based on their "traditional" teaching and research activities. The graduates are linked with an expectation of strengthening regional innovation capacity and enhancing regional competitiveness in the long run. Stephens et al. (2008) deepen the definition of sustainable development by not only focusing on the activities of universities, but also by taking teaching and research activities' content into account. They apply the term "change agent" to describe four paths of university action supporting sustainable RD: (a) providing a model of sustainable practices for society; (b) teaching students how to deal with complex problems and exercise system-thinking; (c) performing practice based research-activities; and (d) promoting and enhancing engagement between individuals and universities situated as transdisciplinary agents. The model of transdisciplinarity, especially transdisciplinary research (Adomssent et al., 2007) as well as transdisciplinary teaching and education (Steiner and Posch, 2006; Muhar et al., 2006) has gained importance in discussing university action and sustainable RD.

There are numerous attempts to grasp the efforts of universities towards sustainable RD outside of their impacts through teaching and research, which are often subsumed under the term "3rd mission" of universities. This "3rd mission" depicts a broader and more adaptive role for HEIs, and their contribution to social, cultural and environmental development based on regional needs (Chatterton and Goddard, 2000; Gunasekara, 2006). In contrast to the unilateral relation of universities and their region through teaching and research, the "3rd mission" requires interaction between universities and regions, and, thus, offers possibilities for HEIs to engage more actively (Arbo and Bennworth, 2007; OECD, 2007). Within the "3rd mission" universities contribute to sustainable development through their technical expertise, cultural mission and role as leaders in the implementation of regional sustainability plans (Arbo and Bennworth, 2007). RD might therefore benefit from the participation of academics in several ways: First, by enhancing a system perspective and critical thinking that support balancing social, environmental and economic factors; second, by helping develop knowledge-based products and services; third, through raising funds; and, finally, these benefits might also increase the acceptability of results in the wider public (Zilahy and Huisingh, 2009). Furthermore, as universities act (1) as prime movers to initiate certain actions within sustainable development processes, (2) as gatekeepers to facilitate access to the regional network, and (3) as bridging institutions between different stakeholders, they also strengthen regional social capital (Devine-Wright et al., 2001).

Depending on the "diffusion channel" through which the university interacts with its region – teaching, research or the 3rd mission – diverse benefits might occur. Despite these potential benefits several barriers and challenges for university participation in sustainable development processes can be identified (Zilahy and Huisingh, 2009; Narodoslawsky, 2001): missing priority for working with regional stakeholders by university staff, a lack of presence of universities within a region, a low appreciation for work in regional sustainability initiatives, a lack of knowledge about inter- and transdisciplinary research methods, and a lack of a clear vision and objectives of the RD process. Behind this background, we elaborate a theoretical framework, which shifts from a mere university perspective to the *process* of sustainable RD.

3. University-society relation in RD processes

In order to analyze the case studies presented here from an environmental planning perspective, we draft an analytical framework to define cornerstones for the university-society relationship in RD processes. The three concepts of planning, learning and implementation theory have proved to be useful in other contexts, exploring environmental and sustainability issues related to planning (Narodoslawsky and Stoeglehner, 2010; Stoeglehner, 2010; Stoeglehner et al., 2009). The chosen theories are in line with the operational sequence of a (regional) planning process: the underlying *planning theory* influences the setting of the planning process, focusing on the "how" of decision making, and the actor constellation – "who" is involved in decision making (Friedmann, 2003); thus, the planning theory approach discusses a) the role the university takes in the decision making process of the overall RD process; and b) the self-perception of the university within this process.

While planning theory establishes a conceptual framework, *learning theory* gives insights into the operational process of decision making, including the questions: Which information is generated by whom and applied in which way? What types of learning can be identified? On what "knowledge basis" are decisions made and how do experiences from past decisions influence the further process? Thus, learning theory supports the understanding of the role of the university to generate knowledge, the ways to transfer this knowledge, and how this knowledge is incorporated within the decision making process.

Implementation theory deals with the question of how approved decisions are transferred into practice and action. Implementation theory discusses, if and how learning processes and their outcomes – knowledge generation and refining of mental models (Lozano, 2011) – influence the behavior and attitude of the actors involved in the RD process. With these premises we discuss potentials for university activities to support sustainable RD and act as "change agents" from each theoretical perspective.

3.1. Planning theory

A comprehensive overview of planning theory related to environmental decision making can be found in Lawrence (2000). For this analytical framework we refer to two planning theories that are explored in more detail: rational planning and communicative planning.

In rational planning theory, planning is seen as problem solving based on scientific considerations and values inherent in society (Fischer, 2003; Lawrence, 2000). The holistic analysis and development of detailed objectives and measures can be derived from scientific reasoning so that planning is an expert driven exercise (Stoeglehner, 2010). The public is then informed about the results. This theory of planning is heavily criticized, as a complete information base cannot be achieved in planning processes due to lack of knowledge and resources; furthermore, planning is a "value-full activity" (Lawrence, 2000) and values cannot be derived on a scientific basis.

The communicative and collaborative planning model tries to overcome problems related to rational planning: by emphasizing deliberation, planning is perceived as a consensus and democratically-oriented communication process between citizens, planners and decision makers (Healey, 1992; Müller, 2004). Participation plays a major role in communicative and collaborative planning and can be differentiated into different levels, depending on the amount of co-determination (see Fig. 1). For instance, according to the Austrian quality guidelines for Local Agenda 21, participation processes have to cover at least stages 1–3 (ExpertInnengruppe LA21, 2010).

The value base for the planning process is carefully considered and expressed by visions that form the centre of the planning process. Information deficits are compensated not by further

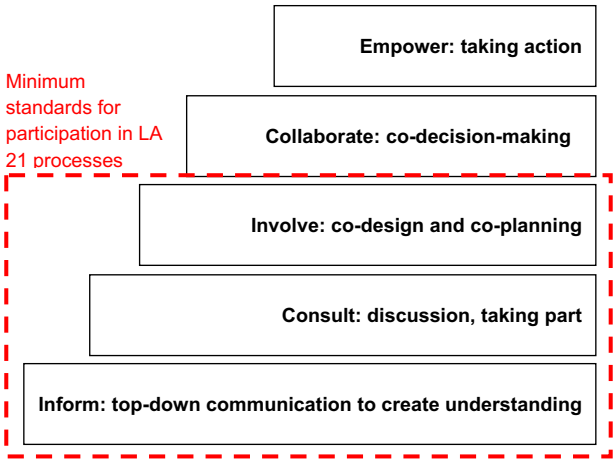

Fig. 1. Levels of participation within the Austrian local Agenda 21 process. Sources: ExpertInnengruppe LA21(2010) and International Association for Public Participation (2007).

surveys as in rational planning, but by deliberation and systematic integration of the value base in the planning process (Dalkmann et al., 2004). Communicative and collaborative planning has constraints, as consensus is often unlikely. Therefore, complex and conflict-driven planning issues may not be successfully addressed (Conelly and Richardson, 2005). Also, interests that are not incorporated in the deliberation process may not be considered, e.g. future generations or the environment (Fischer, 2003).

In order to bridge these planning theories and to combine positive features of the theoretical approaches and their practical implementation, Stoeglehner (2010) proposes a rational-collaborative planning model. Decision-making can be simplified to connecting "a level of values and a level of facts (Fürst and Scholles, 2001) influenced by power relations, concrete situations and actor constellations (Scharpf, 2000)" (Stoeglehner, 2010, p. 220). Therefore, traceable and sound decision-making has to deal with three aspects (Stoeglehner, 2010, p. 221): "a clear and agreed value system (level of values); a well-established information base (level of facts); and clear and transparent rules to aggregate the level of values and the level of facts (aggregation rules)". Furthermore, Stoeglehner (2010) proposes that the level of values as well as the aggregation rules shall be deliberated in a communicative process, whereas the elaboration of the level of facts, the application of the aggregation rules and the integration of interests not present in the planning process should be science-based and founded in rational planning.

Rational planning would solely emphasize the university role as a provider of academic education and expert opinion, while communicative planning and the rational-collaborative planning model would include universities as stakeholders in deliberative processes. This would allow the university to bring factual knowledge, values and paradigms into the deliberative process and, hence, to influence the RD direction towards sustainability; or in other words, allows for being a "change agent".

3.2. Learning theory

Learning is recognized as a key skill to achieve sustainable development (Lozano, 2011), as it helps to change mental models and behavior (Senge, 2006) and to cope with new circumstances and changes. The stakeholders integrated in RD processes form an organization, in the words of Senge (2006), a *learning* organization. Organizations learn through individuals, where learning new skills and implementing institutional creativity helps to develop the organization's capacity (Senge, 2006; Lozano, 2011; Klimecki, 1999). Organizational learning for sustainable development is a complex, iterative and interactive process (Wells, 2009), where different groups of stakeholders and individuals bring in certain (institutionalized) points of view that are guided by deeply rooted mental models. In order to aim for the elaboration of a collective vision and to usher the RD process towards a holistic perspective of sustainability, intensive collective learning processes are needed.

Besides the traditional linear path of learning, where knowing is followed by understanding and this in turn by application (Lozano, 2011), diverse perspectives to classify learning emerge. One of the most widespread is Argyris' (1977, 1993) division into single-loop, double-loop and triple-loop learning. This learning concept connects visions, actions and (perceived) consequences, where learning about consequences might lead to a redefinition of actions and/or visions. In single-loop-learning the level of values remains untouched. Knowledge of undesired consequences leads to adaptation of measures or compensation, but not to a complete redirection of the vision and action programme in order to reach outcomes that are acceptable for the decision-making community. Double-loop learning means that – especially if outcomes might remain significantly negative after the optimization of the action programme – not only measures are redesigned, but also the value base and vision, in which the envisaged measures are grounded, are challenged. The vision is redefined so that new measures arise with sufficiently positive and acceptably negative effects. Triple-loop-learning entails developing new processes or methods to arrive at such reframing (Senge, 2006; Argyris, 1977). Another typology is that of Doppelt (2003), distinguishing between adaptive, anticipatory and action learning. Adaptive learning searches for direct solutions to immediate problems (Shrivastava, 1983); anticipatory learning focuses on avoiding future problems by searching for the best ways to prepare for them; action learning can be defined as ongoing action-outcome relationships, with learning from experiences being involved rapidly in the further learning process (Lozano, 2011).

In the present paper, the classification of Argyris (1977, 1993) is applied as it offers the possibility to grasp the scope of the organizational learning processes on the construction of reality: Argyris connects single-loop-learning processes to incremental action, whereas double-loop-learning is linked to fundamental changes in organizational strategies.

Learning refers to an increase of knowledge through teaching, experience and problem solving (Lorenzo, 2011). In order to analyze the ways universities can act in regions within knowledge transfer and generation we refer to didactics. The "learning pyramid" (Bales, 1996; cited in Blom, 2000) reveals how much of the knowledge raised in a learning exercise is actually received by the learners/receivers of knowledge. It shows that from classical paths of information like presentations and readings only 5–10% of the knowledge is remembered whereas from discussions it's up to 50% and from self-activity up to 80%. This calls for bi-directional interaction between university and society. Mono-directional knowledge provision from university to society might raise awareness and build trust for further in-depth collaboration.

Learning theory offers the possibility to analyze the *process* and *way* of learning. It is no coincidence, that there is a certain connection between the levels of participation (see Fig. 1) and the learning pyramid (see Fig. 2): higher levels of participation can be connected to didactical means (e.g. self-activity) that enhance intensive knowledge transfer and exchange, and, therefore, it is more likely that the transferred knowledge might be brought to action in sustainable RD.

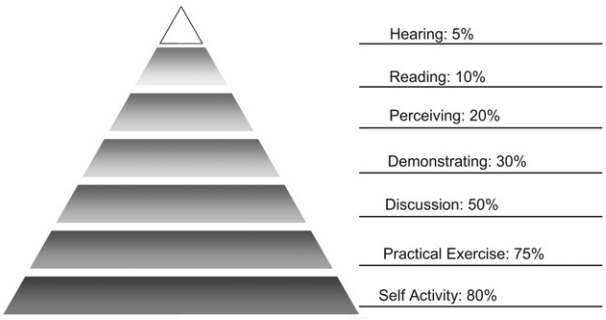

Fig. 2. Amount of knowledge gained through different learning activities – the learning pyramid according to Bales. Sources: Bales, 1996 cited in Blom (2000).

3.3. Implementation theory and the ownership concept

Implementation theory (c.f. Lipsky, 1980; Mazmanian and Sabatier, 1983; Winther, 1990; Sinclair, 2001) was used by Stoeglehner et al. (2009) to propose and ground the concept of "ownership" as an effectiveness aspect for SEA. From implementation theory we can learn that important actors for making and implementing new policies are the so called "street level bureaucrats (SLB)" who are the individuals actually applying new policies. The attitudes of the SLBs towards new policies also shape their implementation, and determine the effectiveness of new policy-related instruments (like SEA). As the attitudes of the SLBs, which are also influenced by their own knowledge, values, agendas, resources etc., may differ from the intentions of the policies, they might substantially change the perception and sense of new instruments. The concept of "ownership" acknowledges the role of SLBs as sense-makers in policy implementation and suggests that ownership is necessary for policy implementation. Elements of "ownership" are (a) ownership of values/concepts; (b) ownership of techniques/processes; and (c) ownership of outcomes (Stoeglehner et al., 2009).

We adapt this concept of ownership to RD processes where a multitude of different actors and stakeholders coming from universities and the region should "own" (a) basic values of sustainability according to the Rio Declaration; (b) the process including research, teaching and process management methods applied, and knowledge gained in the RD process; and (c) outcomes like visions and measures elaborated in the RD process. Ownership is necessary for the regional actors to implement the development strategy, and for the university staff to further engage in activities related to sustainable RD.

In our understanding, "ownership" is an important prerequisite for an effective sustainable RD. Stoeglehner et al. (2009) propose that "ownership" of values and objectives might be supported by double-loop-learning. We argue that this relationship between ownership and double-loop-learning is bi-directional: double-loop-learning is communicative, interactive and reflects values, actions and consequences. These intensive learning processes help to reframe values, attitudes and knowledge of SLBs and may create ownership in all dimensions. Therefore, by providing processes that allow for double-loop-learning, ownership of the process outcomes is created by the involved stakeholders and supports implementation of the RD strategy.

4. Case studies

In order to discuss the potential roles of universities as change agents for sustainable RD we chose two case studies: Montagsakademie (translated: Monday Academy) is an example for the transfer of knowledge from university to the region via lectures, and represents the diffusion channels "teaching" and the "3rd mission". The Montagsakademie case study is elaborated through the application of quantitative and qualitative methods. An online-survey was conducted in 2011 among the participants in the Montagsakademie (722 recipients, return of 10.2%). The target of this quantitative approach was to collect data on the personal and professional benefit from participation of the Montagsakademie, as well as to gather information regarding the benefits for the RD process. In addition, qualitative structured interviews (Bryman and Bell, 2011) have been conducted with different regional stakeholders. Furthermore, the first author participated in the lectures and collected feedback and impressions from the participants. The use of multiple sources of data (triangulation) and methods ensures a high degree of validity and reliability (Collis and Hussey, 2009).

In the second case study, PlanVision (Stoeglehner et al., 2011), a research project was carried out within a spatial planning process and is an example of the diffusion channels "research" and the "3rd mission". As primary methodological approach, action research (AR) has been applied, due to the conviction that a reflexive and dialog-oriented process strengthens the possibility of sustainable change in municipal development projects (Fosse, 2005) and bridges the gap between researchers and practitioners (Bryman and Bell, 2011; Adomssent and Michelsen, 2006). AR is defined as a "participatory, democratic process concerned with developing practical knowledge in the pursuit of worthwhile human purpose, grounded in a participatory worldview" (Reason and Bradbury, 2001). Therefore, in AR participation and action overlap (Stoeglehner et al., 2011).

4.1. Montagsakademie

The Montagsakademie is an initiative of the Karl-Franzens University Graz started in 2004 in the Styrian "Vulkanland", a structurally weak rural region with around 70.000 inhabitants in the south-east of Austria. The case study is focused on the sub-region Kirchbach (see Table 1).

The basic idea of Montagsakademie was to provide education for everyone, customized to the regional demand (Peer, 2007). The title Montagsakademie refers to the knowledge provision tool of evening lectures that regularly took place on Mondays throughout the year. The aim is to enhance discussion between the affected population, local decision-makers and the University, to offer information and knowledge that is relevant for action and provide incentives for (informal) learning processes. The activities led to the following results (Peer, 2010):

Table 1
Short description of the case study 'Montagsakademie'.

Area	Sub-region Kirchbach, consisting of 4 municipalities with around 4.300 inhabitants
Organizing organizations	Karl-Franzens-Universität Graz; KB5 (Education and Learning center Kirchbach)
Kind of intervention	Knowledge transfer by a series of decentralized, ICT-supported lectures
Number of lectures comprised:	15–20 lectures per study year (October to June)
Duration of activity	Ongoing since 2004
Topics covered	All areas of sustainable regional development (environmental, social, economic)
Target groups	Interested public as well as local and regional stakeholders
Number of participants	30–40 in each lecture; about 1.100 persons have participated since 2004 (Steinwender, 2011) equivalent to about 25% of the regional population

- for the rural community and stakeholders involved:
  - getting information and knowhow relevant for action and decision-making;
  - overcoming mental barriers for the inclusion of science in planning and decision-making processes;
  - proposals for lectures and topics for knowledge transfer from the region to the University;
  - innovative ways to participate in lifelong learning through prototypes of "rural universities";
  - awareness raising about "new" topics (renewable energy, the possibilities of ICT etc.);
  - overcoming spatial barriers "…to combine the world of urban knowledge and techniques with the world of the rural quality of life" (Nahrada, 2006).
- for the University:
  - deepening the understanding of local and regional knowledge demand;
  - exchange of knowledge between science and local population;
  - common generation of knowledge throughout discussions;
  - overcoming the barriers of the scientific "ivory-tower";
  - transferring and multiplying scientific knowledge and making it relevant for local and regional action and decision making.

The lectures were customized to the regional demand through collaboration with regional multipliers. Thus, the scientific knowledge disseminated reaches the affected regional population and decision makers. Local and regional educational and higher educational institutions, technology and innovation centres, libraries and private initiatives have been invited to participate as multipliers for their community and region. All of the communities participating have been involved in Local Agenda 21 and/or in LEADER processes. To be capable of transmitting the lectures from the University to the community/region, modern information and communication technology systems (ICT) have been adapted in a new way: via live-stream-transmission through a video conference system, the cooperating regional multipliers took part at the lectures as if they were sitting in the lecture hall, including the possibility of asking questions, discussing etc. In doing so, ICT has been adopted to overcome spatial barriers and distances in information transfer, knowledge dissemination and discussion. Through the exchange of scientific knowhow and local "expertise", a deeper understanding of the knowledge demand could be achieved. That affects the lectures – addressing topics like renewable energies, sustainable lifestyle, organic agriculture etc.

Regarding the efforts of the participating population, the first and foremost benefit was perceived to be enhancement and exchange of knowledge; however, the building up of new contacts as well as motivation for further educational activities has also been mentioned. The benefits of the Montagsakademie for the RD process are identified in increased awareness of the possibilities of ICT for rural areas, strengthening of social capital and an increase in attractiveness of the community/region (Peer, 2012). Concerning the participation of the local population, the Montagsakademie had a socially selective effect as it attracted more people with higher education degrees than people with lower school degrees. The latter experienced the Montagsakademie as too scientific and intellectual.

It should also be mentioned that the dissemination of knowledge was often one-sided, with the University being the provider of knowledge and the local/regional population, decision-makers and regional stakeholders being the recipients. The knowledge achieved *can* be incorporated into regional planning and development processes like LEADER, LA21 or spatial planning but does not necessarily lead to implementation.

4.2. Energy research in Freistadt

The energy research project "PlanVision – Visions for energy optimized spatial planning" (Stoeglehner et al., 2011) comprised several activities. A systems analysis of the relationship between spatial planning and energy supplies, an analysis of legal frameworks and an analysis of ex-post case studies have been conducted, and a co-research process between the University of Natural Resources and Life Sciences Vienna (BOKU) and the rural small town Freistadt was carried out. This last activity is used as case study for this paper (see Table 2 and 3).

Freistadt is located in Upper Austria, around 40 km north of Linz close to the Czech border, has about 8.000 inhabitants and is the regional center of a district with about 65.000 inhabitants in a structurally weak rural area. The aim of the research process was to elaborate on the relationship between spatial planning and development, energy demand and potentials for renewable energy supplies. The activities led to the following results for the partners in the co-research:

- for the Town of Freistadt:
  - detailed data collection and data analysis to work systematically on the relationship between spatial development and energy issues;
  - an energy vision ("Energieleitbild") for the Town of Freistadt, setting ambitious targets for energy consumption, renewable energy generation and greenhouse gas emissions;
  - innovative contents for the new spatial development strategy considering energy demand and supply issues in zoning for residential, commercial and industrial areas;
  - criteria for energy efficiency checks of development proposals for building land;
  - proposals for further renewable energy supply facilities.
- for the University:
  - deepening the understanding of implementation barriers and success factors for energy optimized spatial planning including stakeholder behavior;
  - knowledge development, knowledge testing and knowledge implementation in planning practice about systems relations and implementation in real-life planning situations;
  - development of new planning tools that can be widely implemented;
  - a research project that was listed as strategic energy research project for the preparation of the national Austrian energy strategy.

The co-research process was organized according to AR principles (Greenwood and Levin (1998) involving a "community of

Table 2
Short description of the case study energy research Freistadt.

Area	Town of Freistadt (regional center, 8.000 inhabitants)
Organizing organizations	Municipal Council of Freistadt, spatial and energy planning committee University of Natural Resources and Life Sciences Vienna, Department of Spatial, Landscape and Infrastructure Sciences, Institute of Spatial Planning and Rural Development
Kind of intervention	Co-research
Research context	Integrated spatial development strategy and energy strategy
Topics covered	Energy optimized spatial planning schemes, energy saving, energy efficiency, renewable energy supply
Duration of activity	Feb 2009–Jan 2011
Number of co-research sessions	14 co-research sessions plus one information event for the general public

Table 3
Comparison of the case studies 'Montagsakademie' and 'Freistadt' with regard to the applied theoretical frameworks (own illustration).

	Case study Montagsakademie	Case study Freistadt
Planning theory		
Level of facts	Provision of scientific information and research outcomes	Provision of knowledge as expert opinions (facts and processes)
Level of values	communicating values, visions and objectives based on recent scientific debate	Definition of values and visions including constant reflection and assessment of consequences
Aggregation rules	*No conclusion possible*	Provision of expert knowledge and joint agreement and application of aggregation rules
Learning theory		
Single-loop learning	Deepening of the understanding of regional knowledge demand	Deepening the understanding of measures and consequences to adapt action
Double-loop learning	Awareness raising	Changes of value bases and behavior in decision making towards sustainability
Ownership		
Ownership of values/concepts	Potential to create concernment via customizing contents to the regional demand	Adoption and application of shared visions
Ownership of techniques/processes	Potential to network actors	Understanding of and trust in methods/techniques/processes developed and applied
Ownership of outcomes	–	Implementation of results of planning process in progress

practice" and "friendly outsiders" in "search conferences" and "research arenas". The process primarily took place with the spatial and energy planning committee of the Municipal Council as "community of practice", consisting of local politicians engaged on a voluntary basis and contracted planners. "Friendly outsiders" are on the one hand the researchers from the University, and on the other hand local actors who are familiar with the topic and who were sometimes involved as further stakeholders. The "search conferences" are regular meetings of the "communities of practice" and the "friendly outsiders" with the goal to realize a collective process of inquiry and learning options for all those participating (Greenwood and Levin, 1998; Reason and Bradbury, 2001). The "search conferences" were embedded in the regular meetings of the spatial and energy planning committee of the Municipal Council. The work in the community last for two years between 2009 and 2011 in which University members were present and actively involved in the meetings of the spatial planning committee. Research questions were elaborated together, that addressed visioning and problem solving. Planning tools and outcomes were then developed by the University staff, results were presented and reflected in the community, and with these reflections planning tools were redesigned in order to answer the community questions and work on visions. In the visioning and deriving of measures, the developed planning tools were applied, where the University staff showed possible consequences of the community actions and planning scenarios under discussion, helping the local actors to reflect their value base, visions and proposed actions.

One outcome of the process is a GIS-based planning tool called "energy zone mapping" to estimate the heat energy demand in different areas of the town, show energy saving potentials and define biomass based district heating supply areas under current demand conditions and conditions of energy saving scenarios. These biomass district heating supply areas are used not only for energy planning, but also for spatial planning as the Town of Freistadt decided to direct future building developments to these supply areas so that sustainable energy supplies are available for new settlement projects. Emerging from the co-research process a second biomass district heating system started operation in autumn 2012. The features of the planning tool, database and calculation of results were an outcome of the co-research process: the ability to appropriately and constructively answer community questions was heavily influenced by the local/regional co-researchers. The models underlying the tool can also be applied in other planning processes and were published by the University members in the project report as guidance (Stoeglehner et al., 2011). For the Town of Freistadt implementation of the research results took place, and simultaneously a role model for integrated spatial and energy planning was created including methods that are generally applicable.

4.3. Case study analysis

From a planning theory perspective the case studies investigated can be seen as types of rational-collaborative planning with different peculiarities. The Montagsakademie influences the level of facts via provision of scientific information and research outcomes. Awareness can be created through customizing lecture contents to the regional information demands. In doing so, the University is also able to touch the level of values in the sense of bringing up new paradigms and models. Within a rational-collaborative planning process, the University in the case of the Montagsakademie is still mainly focused on one-way knowledge transfer into the region even if the knowledge demand is surveyed. It cannot be guaranteed that stakeholders and decision makers relevant for RD participate.

The Energy research project Freistadt incorporates the University in the planning process via co-research: applying the rational-collaborative planning model, the University provided knowledge about the level of facts and aggregation and was involved in the communication process where values and visions were defined under constant reflection and assessment of consequences of the proposed planning strategies. This intensive collaboration allowed the University to put forward and test new methods and to gain new scientific factual and process knowledge. For universities, involvement in such rational-collaborative processes as stakeholders also means going beyond classical scientific approaches related to factual knowledge generation. For instance, process knowledge is necessary because scientists have to be prepared to work with laypersons. This also means bridging knowledge gaps and communication barriers.

The role of the university in the planning process is highly linked to the influence on learning, as the process of information processing results in new knowledge (Nonaka and Takeuchi, 1997). From the perspective of learning theory, the Montagsakademie offers information and knowledge for action alternatives, and/or confronts local societies with alternative value concepts and development paradigms, like sustainability, that can be directly

implemented e.g. in LEADER, LA21 and/or spatial planning processes. The Montagsakademie may open up regional adaptation processes through the diffusion of new knowledge, scientific know-how and experiences, and thus raise the efficiency of actions. Yet it leaves the knowledge reflection and incorporation in regional processes as the sole responsibility of the relevant regional stakeholders and decision-makers. Therefore, neither single-loop-learning nor double-loop-learning can be systematically assured as learning loops between values, actions and consequences are not necessarily established in decision making for RD.

In Freistadt the University has been incorporated in a spatial planning process through a co-research approach. This process gives the opportunity to obtain a deeper understanding of the underlying values and facts, the measures undertaken and their consequences as well as decisions made, providing the opportunity for joint discussion. Through co-research, the University has the chance to induce a change in behavior resulting in a common process of value formulation and visioning in the light of anticipated consequences. The outcome "energy zone mapping" is transferrable to any similar planning process so that impact beyond the specific co-research process can be reached. As this tool offers the possibility to change actions and visualize consequences in real-time, it is also feasible for public deliberation to happen e.g. in participatory spatial planning or LA21, as it can be instantly shown how individual decisions concerning energy saving and energy supply influence the whole system. Therefore, single- and double-loop-learning can be supported when the University is enabled to customize and develop knowledge in interaction with local/regional societies.

The implementation of the generated and transferred knowledge is a key aspect for making an impact. According to implementation theory and the ownership concept, street level bureaucrats (SLB) are important actors for implementing sustainability and, thus, influence the effectiveness of development processes. The creation of ownership – as a prerequisite for effective planning and development processes – is intensely linked to the degree of involvement, interaction and cooperation of SLBs. The Montagsakademie has the possibility to network actors, to motivate them and to raise awareness and trust, but as little collaboration takes place it is to be questioned if "ownership" of knowledge emerges. This differs in the case of the energy research in Freistadt, where key actors have been incorporated into the co-research process as equal partners so they get the chance to own common values, visions and actions. Recent developments show that stakeholders proceed in implementing the proposed action. For example, a new biomass district heating system commenced operation in autumn 2012.

5. Discussion

The two case studies reflect two core-activities of universities: knowledge transfer and knowledge generation. On one hand, the case study analysis suggests that for directly influencing any specific RD process like a LEADER-process, LA21 or a local/regional spatial planning process, mono-directional knowledge transfer is not enough, as it cannot guarantee knowledge implementation in a specific RD process for the reasons laid out in the case study analysis. On the other hand, co-research between a local community and the University led to knowledge implementation via adoption of spatial planning strategies and project engineering of a biomass district heating system. Yet, it cannot be concluded from the case study that any co-research process guarantees impacts on sustainable RD. From the case study analysis can be derived, that the main determinants of the university impact on sustainable RD are the level of cooperation between university and society, the chance to reflect the knowledge provided in the actual regional planning and development situations (single- and double-loop-learning) and the potential to create ownership of knowledge by SLBs. These determinants for university action can be organized along the participation levels in planning processes (see Fig. 1).

In order to determine the scope of action for universities wanting to take on the role as "change agents" in specific sustainable RD processes we propose four generic pathways for knowledge exchange between universities and regional communities:

1. Casual knowledge provider: university staffs are engaged in knowledge transfer via information and discussion e.g. as keynote speakers in public participation processes, workshops etc.
2. Providing expert opinions: Providing expert opinions means that certain research questions are addressed to the university and answered by research conducted independently of regional societies.
3. Customized education programmes: Universities may offer customized education programmes where a local stakeholder group defines learning outcomes and an education institution like a university provides a curriculum that fits this learning demand.
4. Co-research: Research questions are jointly elaborated between university staff and local/regional stakeholders, e.g. SLBs in RD.

Casual knowledge provision is punctual and event-like and, therefore, useful to transfer information about facts, values and consequences of certain actions as well as examples from other regions. As no research on the region is conducted, this role is useful for awareness raising, the general definition of questions to be answered and topics to be addressed during the RD process, but without specific intervention. Such activities might provide motivation to take part in a process and build trust for further collaboration between universities and regions that influences RD. As a single measure they are likely not sufficient to substantially influence the knowledge base of a local society (Peer, 2007). Knowledge transfer by information will very likely not create ownership and therefore probably not lead to direct knowledge implementation, as can be derived from the learning pyramid (see Fig. 2). This has to be reflected when expectations are defined on both sides.

Involving external expertise may support knowledge acquisition in participatory planning processes (Herbst, 2000). Providing expert opinion for a university means answering certain questions that are raised by the regional community. This can comprise, e.g. the analysis of problems, weaknesses and potentials, and show possible solutions. Expert opinions can provide factual knowledge for the rational part of the planning process and for aggregating values and facts given a certain regional value frame. Conducting surveys about factual knowledge and informing communities about the results is not enough to pass on knowledge that should be applied. Didactical skills are necessary to provide knowledge in a way that it actively prevails in local action so that single- and double-loop-learning can be supported. Information about factual knowledge alone, even if it is region-specific, is unlikely to create ownership and, therefore, does not necessarily lead to knowledge implementation.

In customized education programmes, organized learning environments are created to transfer knowledge from the university to the region tailor made to regional knowledge demands (Holopainen et al., 2004; Stoeglehner et al., 2006). Knowledge transfer may affect all three elements of decision making: facts, values and aggregation. Depending on contents, organisation and didactical methods the customized education programmes can

support single- and double-loop-learning and can also apply didactical methods that allow for high knowledge infiltration, e.g. by using regional cases for self-activity. As the learning outcomes are defined together with the stakeholders and SLBs of the RD process who should apply the knowledge, ownership of the learning outcomes is supported. Therefore, customized education programmes might already be a result or a research arena of a co-research process: regional knowledge barriers and demand in order to pursue certain development activities and potentials are identified. Curricula can be customized in order to overcome these knowledge barriers through training of stakeholders by university staff. In this way, implementation of sustainable RD can be supported in a collaborative process on one hand, while on the other hand universities have to understand that the training cannot be provided on a regular basis, e.g. in a further education scheme.

Co-research can be grounded in action research principles (c.f. Greenwood and Levin, 1998; Reason and Bradbury, 2001; Schotter and Gustavsen, 1999). In co-research universities might provide factual knowledge, process knowledge and might contribute their values as stakeholder in the deliberation of the value base, and can also gain new insights from the regional process in terms of knowledge base, theory building and methodological developments. Co-research not only activates stakeholders and SLBs, and empowers universities to broaden scientific factual and methodological knowledge; it also can influence the value base of actors involved (including university staff) by double-loop-learning. It also allows anchoring existing and emerging knowledge from the co-research process in regional communities. As local actors (SLBs) are involved in formulating, elaborating and reflecting research questions and outcomes, in our understanding co-research is appropriate to create ownership and to promote implementation. This affects factual knowledge, values and process knowledge.

These four pathways of university action can be linked to participation levels in the following way (see Fig. 3): The role of the casual knowledge provider is linked to information, the lowest level of participation with no chances to act for regional stakeholders (characterized by a uni-directional arrow). Expert opinion can be linked to discussion. Research results are presented and discussed, where the discussion has the primary purpose of explanation (also characterized by a uni-directional arrow). Starting from co-design, a process can be called communicative and participatory, as all actors involved are jointly elaborating on analysis, visions and action plans. Customized education programmes and co-research can both support higher levels of participation with different intensities and directions of knowledge transfer/exchange. While customized education programmes show a time-delayed interaction (survey of the knowledge demand, preparation of education programme, offer of education programme to interested regional stakeholders), co-research is a joint and mutual activity. Intensity refers to the amount of involvement of the university and regional stakeholders. This involvement is characterized by interaction, the amount of time spent together as well as the number of co-decisions made. As shown in Fig. 3, the intensity and direction of knowledge transfer and exchange between region and university is different depending on the participation level and kind of university action. It spans from intense bi-directional co-research empowering local and regional stakeholders to make more sustainable decisions down to direct knowledge provision, which is a one-way transfer from a university to a region.

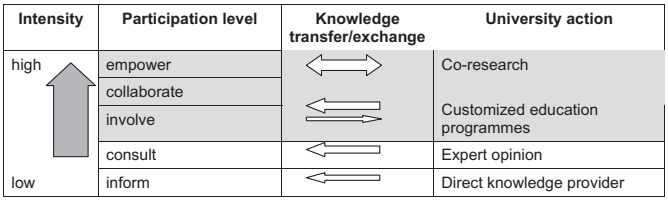

Fig. 3. Knowledge exchange by university action (own illustration).

6. Conclusions: universities as "change agents"?

From this analysis presented we propose that universities that actively want to engage in RD and act as "change agents" for sustainable development might consider going beyond "regular" university activities addressing the diffusion channels "teaching" and "research". Concerning research question (1), how universities can contribute to RD processes, we propose to focus on the "3rd diffusion channel" to reach an active role in sustainable RD, which can be operationalized by customized education programmes, and/or co-research.

For research question (2), if the label "change agent" in the context of sustainable RD processes is adequate, we conclude that knowledge distribution is not enough to establish universities as change agents. In order to reach this effect, ownership of knowledge within local and regional societies, especially within SLBs, on the one hand as well as ownership of customized education and co-research by university staff on the other hand has to be achieved. Therefore, universities that want to effectively act in this field have to thoroughly consider collaborative ways of research and education in organized and/or informal learning environments, so that knowledge demand, knowledge transfer and knowledge generation can be negotiated and jointly determined between local/regional societies and universities.

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