UDC 630*3

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SCIENTIFIC ATELIERS: A TRANSDISCIPLINARY PARADIGM OF INTEGRATING RESEARCH AND TEACHING ON ECO-INNOVATIONS

It is widely acknowledged that transformation of a society towards a sustainable pattern demands an effective collaboration of all stakeholders and intensive knowledge exchange within a well-known triangle academia-business-society. Skills and competences for dealing with highly complex and ill-defined problems have to be developed in order to effectively cope with sustainability challenge. Atelier as a specific form of transdiciplinary case studies occupies a fitting place in this variety of educational eco-innovations aimed at sustainability learning. Atelier paradigm, ontology, methodology and management are examined.

Key words: *eco-innovations, sustainable development, scientific ateliers, multidisciplinary study, ecological economics.*

Introduction. Radical shift in civilization development paradigm, caused by threatened state of the enveloping and sustaining global ecosystem [1] served as a motive to rethink nature and quality of human development in general and economic growth in particular. Aroused paradigm of sustainable development challenged humanity and forces it to reconcile conflicts between environment, society and economy. But the first of all it challenged modern science, dominate scientific picture of the world designed under the strong impact of the reductionist approach.

The fact that the mechanistic worldview predetermined the first scientific picture of the real world resulted in considering a motion as a movement but not as a change, and therefore things were treated as unchangeable. Unchangeable physical bodies (sometimes called objects) without history and possibility to develop, their behavior when they are subjected to forces or displacements, outlined scope of the science substantiated classical scientific paradigm.

Standing in contrast to Descarte's scientific reductionalism synergetics [2–3], an interdisciplinary science explaining the formation and self-organization of patterns and structures in open systems far from thermodynamic equilibrium, proves that such world-view is only a part of the whole true about the real world. Ludwig von Bertalanffy's general systems theory (1936) [4] embraced by synergetics, created an interdisciplinary framework demanded by post normal science [5–6].

Non-linearity, self-organization and evolutionism feature ecological-economic systems. Urgency in decision-making, uncertainty of facts, impossibility for experimentation because of sample size of one requires new interdisciplinary instruments for tackling aroused challenges [1].

The shift in scientific paradigms supposes a formation of relevant innovative educational models, which combine different sciences concepts and frameworks as well as academic and traditional knowledge. To fill this gap in education for sustainable development a transdisciplinary case study (TCS) model was designed to facilitate knowledge exchange between science, policy and everyday practice in a straightforward and comprehensive way.

The paper is aimed to examine the paradigm of scientific atelier as a transcfisciplinary approach to education for sustainability.

Scientific ateliers as an example of transdisciplinary case study. *Transdisciplinarity* can be defined as an integration of values and knowledge from society into the production of scientific knowledge [7]. In contrast to multidisciplinarity and interdisciplinarity, it does not limit itself to linking different scientific paradigms, but in addition to the integration of stakeholder and expert knowledge and values, the problem determines the appropriate tools and methods, not the discipline [8].

Note that multidisciplinary study involves researchers from different disciplines to investigate a

problem from these disciplines perspectives and provide several non-integrated findings developed using different methods and concepts, which contribute to and cover all the breadth of the problem under consideration (fig. 1).

However interdisciplinarity assumes integration of scientific perspectives, concepts and tools to obtain a single coherent understanding of the problem. Participatory approach brings together different stakeholders, like academia, business, local population etc. Peculiarities of recent forms of knowledge production are presented in Table 1.

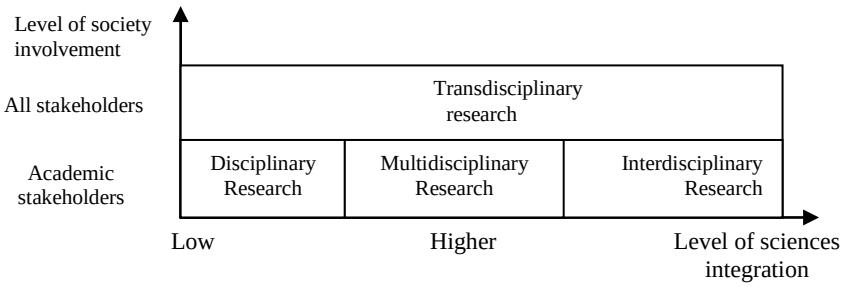

Fig. 1. Transdisciplinary research in relation to other forms of knowledge production

One of the first transdisciplinary case studies (TCS) in Europe was undertaken at the Institute of Human-Environment Systems Natural and Social Sciences Interface at the Swiss Federal Institute of Technology in ETH Zurich in 1994 (Eidgenössische Technische Hochschule). Nowadays European universities arrange a lot of transdisciplinary case studies. Gained experience of innovative teaching was discussed at a symposium on "Transdisciplinary Case Study Research for Sustainable Development" (Helsinki, June, 2005) and is highlighted in the International Journal of Sustainability in Higher Education (2006) [7]. Applying transdisciplinary case studies as a mean of organizing sustainability learning becomes an effective and popular form of mutual learning by doing and it allows academia to implement developed findings in real world conditions.

In the United States, the Gund Institute for Ecological Economics (GIEE) has pioneered the scientific atelier, a self-designing, collaborative process for solving real world problems. Ateliers are designed to integrate insights across disciplines and institutions, as well as research, learning, and service. This approach brings students and faculty from several disciplines together with a broad cross-section of stakeholders in problem-focused, adaptive, workshop settings, frequently in countries that are less developed or undergoing transition to a market economy. The ateliers focus on a particular research topic and produce a variety of publications ranging from academic journal articles with practical policy implications that represent a new transdisciplinary synthesis of the problem to grant proposals and policy papers. The approach assumes "peer-to-peer" interactions among the participants, and all participants share the common goal of addressing the chosen research topic from their particular perspective and sharing their own learning about other perspectives.

Atelier organizers typically choose the research topic in collaboration with a local partner and assemble a number of component resources that are available for use during the course. These resources may include lectures on specific topics, computer modeling hardware and software, reference data and literature, and training in collaborative problem solving. Research is problem-driven rather than tool-driven, but an effective workshop requires that appropriate tools be available. Some of the Gund Institute's experience with TCS is presented in *Ecological Economics: A Workbook for Problem-Based Learning* [9].

The main advantages of ateliers include [7]:

- Building researchers', students' and stakeholders' capacity for real-world problem solving;
- Creating new knowledge with practical applications for both academia and society;
- Stimulating students to generate new knowledge and to prepare for future professional lives;
- Developing a new educational model integrating conventional lectures with field-based teaching and internet-based education;
- Facilitating dialogue and mutual understanding among academia and community, and among stakeholders within a community;

- Improving communication, knowledge dissemination, and collaboration between academia and society as a whole.

Table 1

Synopsis of recent forms of knowledge production

Form of knowledge production	Features of the form
Disciplinary Research	▪ Object of research lies within a particular science scope ▪ Well-defined academic research methods are used in research ▪ Development of new knowledge or theory within specific discipline
Multidisciplinary Research	▪ A research task (real-world problem) relate to several sciences ▪ Each scientific group – Works within own framework – Uses own methods for research – Provides own scientific picture ▪ Result of research consists from several distinctive perspectives ▪ Lack of discipline cooperation and data exchange
Interdisciplinary Research	▪ A real-world problem relate to several sciences ▪ Integration of framework, data, research methodology (redrawing scientific map) ▪ Result of research is single integrative framework which provide a holistic view of the problem and way of its solving
Transdisciplinary research	▪ A focus on a real-world problem ▪ Ensures co-learning and collaboration among academic and non-academic stakeholders (encouragement of traditional knowledge) ▪ A problem under consideration dictates a research methodology ▪ Applying of participatory approach to interdisciplinary research

As our experience suggests simply implementing an atelier in local community induces a flow of benefits both for academia (papers, monographs, further researches) as well as social (new level of stakeholders' collaboration, knowledge dissemination, perception of own connection and responsibility for changes toward sustainability) etc.

According to Scholz *et al*. (2006) [7] the core patterns of TCS theory are: ontology, epistemology, methodology and project management conceptualization. We present the atelier paradigm following this framework and using example of a particular atelier.

Ecological Economics and Sustainable Forest Management Atelier. As an illustration of a particular atelier we will use one of the latest ones, which dealt with ecological economics and SFM. Last autumn GIEE and the Institute of Ecological Economics (IEE), Ukrainian National Forestry University (UNFU), applied the atelier approach to tackle problems on a way of transition forest management toward a sustainable pattern. The international atelier 'Ecological Economics and SFM in the Ukrainian Carpathions' took place in Lviv and Transcarpathian regions in fall of 2007.

UNFU is one of the Ukrainians leaders in the field of greening curriculum. This process was originate under several Tempus Tacis projects namely P_JEP02169-95 'Natural Resource Economics' (NARECO), JEP_T 10255-96 'Environmnent and Nattural Resource Economics' (ENARECO) and D_CP-20575-1999 'Dissemination ENARECO' (DENARECO).

Together with Universities of Freiburg (Germany), Gent (Belgium) and Padova (Italy) we developed one and a half year master program aimed to prepare high-level specialists in field of society transformation towards sustainability. Each EU University provided scientific expertise in relevant areas and training.

The main peculiarities, that differ ENARECO master program from a plenty of newly established programs in the field of sustainable development, are:

- The basic theme for all classes is the question how economic and societal demands can be rendered compatible with the requirements of conservation and careful use of natural resources.
- The teaching contents of the course are not limited only to concentrating on the theory of environmentally friendly economics, but attempts practically illustrate principles of the various sectors of a political economy. Hence students are expected to become experts, capable of implementing the principle of sustainable development in practically all-relevant areas of economy and society.
- The central concern of the program is a practice-oriented education.

- The new study program is open to graduates from different fields. It is not restricted to economists, but open to geographers, law students, forest scientists, ecologists and others [11].

It has to be mentioned here that Ukraine now establishes own economic system, which is being transformed from a centralized to a market one. In the mainstream of these much-needed changes are questions of building a proper property system to enhance natural capital of the country; one of the main components of it consists of forests. Ukraine has a low percentage of forest cover and an overall deficiency of forest resources [12]. Value of forest resources and forest ecosystem functions is very high. At the same time forests are located over the territory in a very irregular way: in steep zone forest cover is 1.32 million ha (5.4 %) and in the Carpathian it is 2.08 million ha (36.7 %) accordingly. Forest of Carpathian region habitats a lot of endangered species, high biodiversity features Carpathian forests [13–14].

In the same time permanent bias toward harvesting forest over maintaining natural capital drives revenue-searching decision-makers to destructive natural resource management despite high dependence of local population on such ecosystem services as water supply and water regulation. The urgent and vital question is how to balance business and environmental interests in a market system being developed, how to make compatible meeting primary needs with achieving sustainable development standards.

The atelier brought together scientists and students from US, Sweden and Ukraine, forest experts and entrepreneurs, local community representatives and environmental NGOs for the sake to highlight challenges, obstacles and drivers toward implementing SFM in conditions of transition economy.

Methodology. The basic principle in ateliers is that the problem being addressed determines appropriate methods, not disciplinary boundaries [8]. While ecological economic ateliers typically define problems at least partially from the perspective of three critical issues—ecologically sustainable scale, socially just distribution, and economically efficient allocation—the specific problem still determines the specific method for addressing each of these issues. Nonetheless, there are a number of general methods such as problem decomposition, analysis, synthesis, brainstorming, communicating, web-based teaching, and backward planning that are broadly applicable in most ateliers [7, 10].

The problem specific methods are by nature the most interesting and the most difficult to describe generically. Possibilities include deep interviews, focus groups, and questionnaire development; rapid ecological assessment techniques (e.g. of stream ecological integrity); quantitative techniques like statistical analysis and valuation of ecosystem services; policy analysis; and advanced computer based systems modeling. Participants choose the most relevant methods for a specific case study or for the facet of that case study they choose to address.

The EE and SFM in the Ukrainian Carpathians atelier brought together scientists and students from the US, Sweden, and Ukraine, forest experts and entrepreneurs, local community representatives and environmental NGOs. Thus prevailing in university teaching classical model ‘sender-receiver’ (Fig.2) was substituted by new integrative model (fig. 3) of stakeholders’ co-learning [15–16].

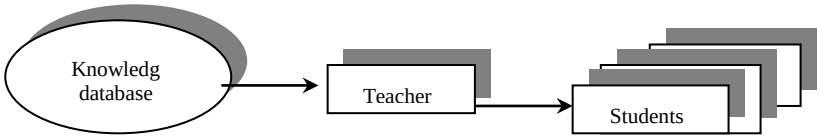

Fig. 2. ‘Sender-receiver’ model of teaching

The expertise of the various academic participants proved highly complementary and was effectively integrated with local knowledge and ability. For example, one group used relevant software to examine services generated by local forest ecosystems, identified ‘stakeholders’ preferences regarding these services using conceptual content cognitive mapping techniques, and examined those preferences by means of non-parametric statistic analysis [17]. Changes in landscapes were traced from a historical perspective using previously compiled databases. Atelier results may take many months to be finalized, and EE and SFM in the UC results are still being written up.

Atelier Management. An atelier *per se* is an important and multifaceted scientific event and naturally it demands relevant managerial efforts. Usually web-based courses and an appropriate spade-

work help a lot to participants to use a precious field time in the most effective way. Main stages of the aforesaid atelier are: (1) Spadework, (2) Atelier, and (3) Final work.

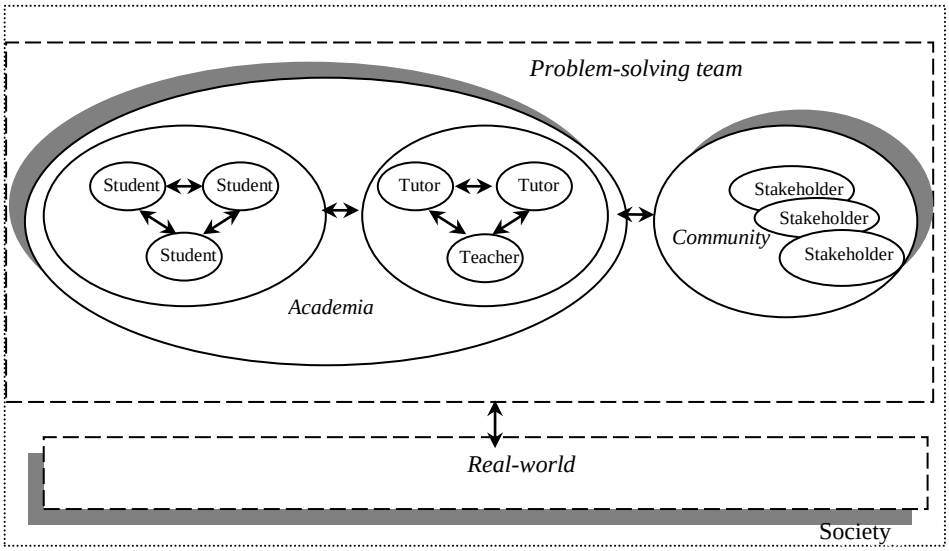

Fig. 3. Model of interactive problem-based mutual learning

The Spadework stage involves:

1) Choosing a problem, 2) Crystallizing atelier idea, 3) Announcing atelier, 4) Panel lecture on scientific environment regarding a case study, 5) Familiarization with a case study, 6) Enrolling students, 7) Selecting scientific team, 8) Developing relevant net, 9) Designing atelier web-site, 10) Building appropriate internet-based curriculum, 11) Self-regulated learning.

The Atelier stage assumes: scientific conference, field trips, discussion with stakeholders, team learning, stakeholders interviewing, data collection, team discussion, scientific expertise, preparing draft of recommendations, discussion of further investigation, debates on future publications, preliminary preparation (questionnaire, techniques, database etc). The final work contains: research, recommendations for a real world problem solving, papers, books, publication of main results on a web-site, conference.

Talking about above-mentioned atelier in Ukrainian Carpathians it is worth to mention that all preparations were done by faculties and students of GIEE and IEE. This phase of atelier development induces a lot of academic contacts both personal and institutional. Common search of relevant sources in periodical press, monographs, e-space brought benefits for both sides and resulted in a huge volume of relevant publications. When resources are available, preliminary visits can be quite useful; for example GIEE scientists visiting the IEE delivered a series of lectures on ecological economics, and IEE scientists visiting the GIEE presented a panel on Bioconservation Trends in Eastern Europe).

Atelier realization demands some special skills from its managers to ensure suitable and acceptable field-trip logistics, efficient use of a precious field time, relevant data collecting, comprehensive interviewing and numerous and fruitful discussions with stakeholders. Without any doubts we can say about an important role of the final stage. Accurate documentation, illustration and concluding home research will make an atelier constructive and creative. Dissemination of atelier participants' findings among all participants, stakeholders (especially out of academia) will bring a lot of benefits to community first of all.

Atelier findings. Ateliers as a form of TCS have a lot of outcomes. They can be organized in three groups: educational, scientific and social. Addressing the first group – educational benefits several items should be mentioned [17]:

- Innovation form of sustainability teaching is pioneered /updated;
- Self-regulating sustainability learning is originated / improved;
- Cross-institutional knowledge exchange is facilitated;
- Sustainability capacity-building curriculum and didactics is enriched;

- A fruitful blend of academic lecturing, problem-based learning and internet-based education;
- Interdisciplinary and collaborative teaching model for mutual academia and society learning is designed and implemented.

Viewing ateliers' result from a scientific perspective we have to mention following:

- New approaches, tools and techniques usually accompany conceptualized case study of specific phenomena caused by human activity in ecological-economic systems;
- Scientific knowledge are complemented by knowledge of a society, community and / or stakeholders;
- Strengthen relations between university education and science. It should be mentioned here that in former USSR an university education was decoupled from pure scientific research, hence the question of establishing strong links among them pays special attention from the Ukrainian Ministry of Education and Science.

And indeed, the last but not the least – social benefits, the third pillar of the sustainable development:

- Communities involved in atelier development obtain a powerful surge of knowledge, ideas, scientifically-grounded recommendations toward implementing eco-innovations in business, professional and personal environment;
- Communities established links to academia;
- Creative and fruitful polylogue among stakeholders was originated;
- Students familiarized themselves with a real-world problem and community capacity-building methodology they will face throughout those future careers;
- Institutions and communities improved cross-cultural relations.

Conclusions. Basic premises of evolving paradigm of post normal science [18] are: investigated phenomena are evolutional, context- and values dependent and hence decisions are subjective and Illuminate, dialog and co-operative learning are essential. Under these conditions new style of behavior, policy and teaching is demanded. An atelier methodology as an advanced form of TCS approach to real-world problems solving is needed to help society as whole and to community in particular to tackle sustainability challenges.

Indeed, such science-intensive decade, to be proposed by an atelier, which combined international conference, panel lectures and discussions, field trip and group work, brought a sharper insight of a real-world problem, improved existing model of problem-based interactive learning and enrich it through concrete examples of community capacity-building activity, induced a plenty of further research, papers and other inter- and transdisciplinary and cross-cultural exchanges. It helped local stakeholders to understand real character of existing problems, possible scenarios and trends of their development, instruments and arrangements for dealing with such problems according to the sustainable development strategy.

As we are convinced now ateliers, TCSs are essential part of education for sustainable development on the whole and in approaching SFM in particular. Weak links between practice and forest research could be mentioned as one of subjective limitations on the way of dissemination of new knowledge [19], especially knowledge on eco-innovations, processes that contribute to sustainable development.

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НАУЧНЫЕ ЛАБОРАТОРИИ: МЕЖДИСЦИПЛИНАРНЫЙ ПОДХОД К ИНТЕГРАЦИИ ИССЛЕДОВАНИЙ И ПРЕПОДАВАНИЮ В СФЕРЕ ЭКО-ИННОВАЦИЙ

Трансформация общества в сторону устойчивости требует эффективного сотрудничества всех заинтересованных сторон и интенсивного обмена знаниями между наукой, бизнесом и обществом. Для решения вопросов по сложным проблемам требуются знания и компетентность, чтобы эффективно отвечать на вызовы современности. Научные лаборатории являются специфической формой междисциплинарного обучения эко-инновациям. Рассматриваются вопросы методологии и управления таких лабораторий.

Ключевые слова: *эко-инновации, устойчивое развитие, научные лаборатории, междисциплинарные исследования.*

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