INNOVATION COMPETENCY DEVELOPMENT AND ASSESSMENT IN HIGHER EDUCATION

F. Watts¹, L.E. Aznar-Mas¹, T. Penttilä², L. Kairisto-Mertanen², C. Stange³, H. Helker³

¹ Universitat Politècnica de València (SPAIN)
² Turku University of Applied Sciences (FINLAND)
³ Hamburg University of Applied Sciences (GERMANY)

fwatts@upv.es, laznar@upv.es, taru.penttila@turkuamk.fi, liisa.kairisto-mertanen@turkuamk.fi, christiane.stange@haw-hamburg.de, helmut.helker@haw-hamburg.de

Abstract

Changes in higher education paradigms have placed at the forefront the development of knowledge, skills and attitudes that will equip students with the competencies necessary to succeed in the workplace. In innovation pedagogy, a learning approach in which students have the opportunity to become innovative members of learning organizations, the social aspects of working and learning are emphasized. Group processes where learning happens in multidisciplinary teams form an essential part of learning. The aim of innovation pedagogy is to generate environments in which a competitive advantage can be created by combining different kinds of know-how. Innovation competencies sharpened by innovation pedagogy are the key to acquiring new competitive advantages via know-how.

This paper describes the progress of an ongoing project on the development and assessment of innovation competencies. The project has received the support of funding through the Life-long Learning Programme of the European Union. The main objective of the project is to create an instrument that will measure outcomes when using innovation pedagogy. The instrument focuses on assessing students’ performance in situations that produce samples of capacities and skills that make up innovation competencies.

The Innovation Competency Development Project includes four European partner universities: Turku University of Applied Sciences from Finland, Universitat Politècnica de València from Spain, University of Applied Sciences Hamburg from Germany and Karel de Grote-Hogeschool Antwerpen from Belgium. Each partner heads a different part of the project, which will finalize at the end of November 2013. The first two work packages, which represent approximately 50 % of the total workload of the five packages, have concluded at the time of writing. The Innovation Competence Barometer (ICB) is currently being piloted in the four universities in order to complete the validation procedure of the instrument. The five work packages will be described in the paper and preliminary trial results will be presented.

The main contribution of the project is the discussion on how, through using the ICB and testing the results of different teaching and learning methods, universities can get up-to-date information on the usefulness of the methods and can make decisions on their implementation on a wider basis. Ultimately, it is the businesses and organizations that will benefit from the newly educated professionals who will possess better qualifications and be better prepared to act in diverse innovation processes in their working lives.

Keywords: Innovation competency, competency development, innovation pedagogy, higher education, assessment.

1 INTRODUCTION

The increasing demand for a broad perspective of knowledge that transcends disciplines and professions is leading higher educational institutions to adopt teaching and learning methodologies that will equip students with the competencies necessary to succeed in the working world. Innovation pedagogy is a teaching and learning approach that defines in a new way how knowledge is assimilated, produced and used in a manner that can create innovations [1,2] Students learn what innovation means and how to unfold their own potential for innovation. The question remains,
however, of how to assess the achievement of the learning objectives and, thus, the effectiveness of the methodology.

This paper reports on the progress of the Innovation Competency Development (INCODE) Project, which addresses the issues of development and assessment of innovation competency acquisition. INCODE includes four European partner universities: Turku University of Applied Sciences (TUAS) from Finland, Universitat Politècnica de València (UPV) from Spain, University of Applied Sciences Hamburg (HAWH) from Germany and Karel de Grote-Hogeschool Antwerpen (KdG) from Belgium. Each partner heads a different part of the project, which is funded under the European Union’s Lifelong Learning Program and will finalize at the end of November 2013. The relationship struck up among the four partners promises to continue further development of the project results after the project itself has finished.

TUAS has been an active developer in the field of educational methods based on working life and was the first university to launch the concept of Innovation Pedagogy. As editors of the first publication on the topic in 2009 [1], with the corresponding publication in English in 2011 [2], TUAS took on the role of lead partner in charge of management and coordination of INCODE, following the logic that examples of innovative learning call for proof that the methodology results in heightened innovation competencies of the participating students.

The innovation competencies contemplated by TUAS follow the European Qualifications Framework which comprises three levels of generic individual, communal and networking competencies. The individual level includes independent thinking and decision-making; target-oriented and tenacious actions; creative problem-solving and development of working methods; and self-assessment and development of one’s own skills and learning methods. The student is able to self-assess and develop his/her own skills and learning methods. The interpersonal level focuses on the ability to co-operate in a diversified team or working community; ability to take the initiative and to work responsibly according to the targets of the community; ability to work in research and development projects by applying and combining knowledge and methods of different fields; ability to work along the principles of ethics and social responsibility; and ability to work in interactive communication situations. Finally, the network level covers the ability to create and maintain working connections; ability to work in networks; ability to co-operate in a multidisciplinary and multicultural environment; and ability to communicate and interact in an international environment.

The INCODE Project builds on the development work done earlier at TUAS to undertake the development of an instrument that will be the required measurement tool, the Innovation Competence Barometer (ICB). UPV has brought to INCODE experience in active learning and assessment methods and is in charge of the development of the ICB. In the third part of the project, TUAS has the responsibility for overseeing the implementation and piloting of the ICB in what are called Research Hatcheries (described later). KdG watches over the assurance of quality control throughout the project. And HAWH manages dissemination and exploitation of results of the project, which includes rater training, a most important aspect that must be considered in the future use of the ICB, the new rating tool. All partners are actively involved in the different parts of the project.

2 THE INNOVATION COMPETENCY DEVELOPMENT PROJECT

The unfolding and development of innovation competencies in students is the aim of Innovation Pedagogy, to which end the design of the curriculum includes the promising teaching and learning teaching method called Research Hatcheries (REHA) (see section 4), in which the students carry out tasks which help to develop their innovation competencies in three dimensions: individual, interpersonal and networking. The primary objective of INCODE is to design and validate the measuring tool, the ICB, which is needed to measure the usefulness of new learning methods based on research, development and innovation (R&D+i), such as the REHA. The project also proposes to design the training necessary for raters to use the ICB, as is all set out in the diagram below.
The idea of the ICB was inspired by the on-going Assessment of Higher Education Learning Outcomes (AHELO) process, a recent global initiative led by the OECD (Organization for Economic Co-operation and Development). The AHELO group has made the decision to use the existing Collegiate Learning Assessment tool to measure generic skills through assessment of written performance. The skills to be assessed are critical thinking, analytical reasoning, problem-solving and written communication. INCODE has developed complementary criteria to assess certain generic skills through oral performance tasks, the skills which pertain to a broad area called Innovation Competencies. The first phase of INCODE included the definition of Innovation Competencies.

The development work of INCODE's barometer started with the definition of innovation competencies, followed by the creation of the assessment rubric and grid as the base of the ICB. The alpha version of the ICB was tested in all partner countries and the data analyzed. The ICB is currently being used in the experimental pilots in the second project year.

The proposal and validation of the assessment rubric for innovation competence has followed the steps set forth in the Instrument Development and Construct Validation methodology informed by Onwuegbuzie et al. [3]. The first four of the ten steps posed have been completed and INCODE is well into step number 5, field testing the revised instrument. The 10 steps are as follows:

1. Conceptualize the construct of interest.
2. Identify and describe behaviors that underlie the construct.
3. Develop initial instrument.
4. Pilot-test initial instrument.
5. Design and field-test revised instrument.
7. Validate revised instrument: Qualitative analysis phase.
10. Evaluate the instrument development/construct evaluation process and product.

The initial activities of the UPV team comprised an extensive review of the literature, in-depth interviews with human resource managers from different firms that are well-known for their innovation and participation in a focus group meeting of research and development managers, the results of which have been published in part [4,5,6,7,8].

The first proposal presented by UPV served the purpose of opening discussion among partners. It included definitions of the terms that would be used (competence, innovation); the characteristics of a
competence, i.e., that it be integrative, combinatorial, ongoing, contextual and evolutionary; a hierarchy of the components of competence (competence, capacity, skill); and the five most important capacities considered by UPV to be contained in innovation competence, i.e., creativity, initiative and leadership, forward thinking, communication and team work.

After discussion among the partners, it was agreed that the future ICB would contemplate the three dimensions set forth by TUAS. Innovation competence would thus include an individual, an interpersonal and a networking dimension, which in turn would include different capacities such as those proposed by UPV.

3 THE INNOVATION COMPETENCE BAROMETER

The first versions of the ICB were revised and the testing situations were selected. Finally a trial rating of two video recordings took place with all partners present and served the purpose of training the lead raters from each country. The “pre-piloting” of the ICB led to the reduction of the number of items to avoid redundancy. The ICB and instructions for use were sent out to all partners to be used in validation, which included 2 raters each from the 4 partner universities who rated 8 videos that had been produced at the different partner universities (2 each). All the data from the ratings (8 videos X 8 raters) were centralized and is presently under statistical analysis for validation of the instrument.

English was used to formulate the trial version of the ICB, in the testing situations and in the whole validation process. For actual use in the field it was necessary to translate the ICB into the languages used at the partner universities (Finnish, Flemish, German and Spanish). As the students would be speaking the language of the countries, the item that refers to speaking foreign languages was omitted for field testing, although the finished product will include that capacity, considered by all partners to be a part of innovation competence. In addition, the form of the ICB was adapted to use in peer assessment and self-assessment, as shown in the self-assessment grid below.

Table 1 Self-assessment of innovation performance.

<table>
<thead>
<tr>
<th>INDICATORS OF CAPACITY / SKILL</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INDIVIDUAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 I make proposals appropriate to the demands of the task.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 I offer ideas that are original in content.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 I offer new ways to materialize the ideas.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 I critically evaluate the fundaments of contents and actions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 I identify relationships among different components of the task.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 I approach the task from different perspectives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 I use resources ingeniously.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 I foresee how events will develop.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 I show enthusiasm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 I am tenacious.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 I take intelligent risks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 I orient the task towards the target.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INTERPERSONAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 I transmit ideas effectively.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 I listen to teammates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 I use dialogue to establish constructive group relationships.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 I collaborate actively.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 I contribute to group functioning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 I take initiatives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 I move others to act.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 I confront problems constructively in order to reach a consensus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NETWORKING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 I apply ethical values.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 I add social impact to task.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 I can work in cooperation in multidisciplinary / multicultural contexts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 I make working relationships with actors engaged in local, regional or international endeavors.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations:
5 = Excellent; 4 = Good; 3 = Pass; 2 = Needs to improve; 1 = Needs to improve very much

4 RESEARCH HATCHERIES

The field testing phase of INCODE, led by TUAS, comprises experimental piloting at each partner university. Pilot experiences embrace new ways of embedding on-going research into teaching and learning. The aim of the pilots is to enhance innovation competencies of students and to generate social, technological, ecological or commercial innovations.

The main teaching and learning method implemented in the experimental pilots is the Research Hatchery (REHA), a concept for combining learning, innovation and research. The actors of a research hatchery consist of students, student assistants, an R&D expert and a project leader or teacher. Research subjects arise from real-world needs for new information and are focused on the following themes: ageing, sustainable development, globalization, and improvement in framework conditions for businesses to innovate. Students take on different responsibilities of the research and obtain credits (the amount differs among universities) for their work. More experienced students act as tutors. Meetings organized at regular intervals aid in keeping different subprojects together. Learning occurs in different ways: through self-study, counseling and guidance as well as with the help of fellow students and more experienced researchers. During the REHA studies, it is possible for students and teachers to try out different working routines and make mistakes [9,10,11,12,13,14].

The main activities of the field testing phase were subdivided into four phases: planning, implementation, analyzing and reporting. The major achievements and results thus far have been:

- The decision of the scientific themes for the pilots at each university based on the university’s on-going research operations;
- Defining those teachers and R&D experts in charge of pilots at each university (teachers are in charge of choosing pilot groups of students);
- Defining the operational arrangements of the pilots, such as the arrangements of Research Hatcheries in all partner countries (each university has been able to modify this basic concept to meet their conditions).

Operational arrangements have included, for example, dividing into small groups, naming senior students to act as research assistants, holding group counseling by R&D expert and teacher on a regular basis, carrying out research work either at home or at the university’s facilities, storing and making easily accessible all the material the students need during the project, reporting the results of the first round of pilot REHAs and ensuring that REHAs continue during the second round of pilots.

Students in the pilot REHAs are evaluated by using the new ICB tool. The results emerging in the first round will help to update and polish the format and other details of the ICB, which in turn, will help to update the REHAs.

5 RATER TRAINING

HAWH is the leader of the dissemination and exploitation functions in INCODE. In addition to dissemination activities such as the production of flyers and the layout of brochures, the work comprises the construction and administration of a project-website and the organization of a final INCODE conference. Exploitation involves, among other tasks, drawing up a training course for raters.

As shown in the general overview in Fig. 1, the training course for raters is a means to assure the quality of the ICB by focusing on the skills of those who apply the instrument. Design starts from the assumption that innovative power (skills, attitudes) in students consists of different components that
together form a cluster competence called Innovation Competence (IC). For this reason, it is not only important to assure that the different individual traits of IC are observable in the context in which they are evaluated by the ICB but also that they can be discriminated and assessed by different users of the instrument. Mainly, the instrument will be used by teachers and pedagogical staff who have different backgrounds and experience and who are not familiar with the assessment criteria and their use in Research Hatcheries.

For the use of the ICB, the quality of the collected data depends to a relevant extent on the systematic preparation of the raters. To assure the application of the psychometric quality standards when using the instrument therefore presupposes special training of the raters. The following paragraphs outline several general features of rater training which can be combined with special aspects of assessing the IC of students.

5.1 Threats to the reliability of ratings

The construction of the ICB presupposes that raters who apply this instrument to assess innovation competence are able to secure consistent and accurate results. The assessment of oral performance implies a rater’s ability to multi-task. The raters’s focus has to lie at the same time on the group as well as on the individual group member, on verbal as well as on nonverbal behaviour, on the overt content as well as on the subtext, on perception of behaviour as well as on the scales and concepts of the ICB. And, on the other hand, raters have only a limited capacity for processing information. In such a challenging situation different raters may use different strategies to cope with the task and may not use the same strategies all the time. It seems safe to assume that raters will not be able to maintain rating consistency; in other words, intra-rater reliability will be low. Another problem may arise from personal differences between raters, who might differ in experience, language proficiency, self-confidence, commitment to the task, relationship to the ratees, cultural background, etc. Therefore, the degree of agreement between raters, or inter-rater reliability, could be rather low, too.

Rater training to improve the reliability and accuracy of performance assessment seems to be indispensable. Numerous studies have shown how rater training can be effective [15,16,17,18]. In a first ICB rating session with 19 raters [8], the high number of missing ratings and of fall-back on the option n/a (not applicable) also confirmed to the partners in INCODE the necessity of rater training.

5.2 Types of rater training

While the early training models for raters focused mainly only on one single cause for rater inaccuracy, in the INCODE-project we will choose a combined approach consisting of rater error training (RET), behavioural observation training (BOT), and frame of reference training (FOR).

Rating errors reduce the reliability, validity, and utility of the evaluation of innovation competence behavior. It is critical for raters to be aware of and acknowledge their own biases. Raters who are familiar with these errors should take steps to minimize the effects, which will significantly raise the objectivity of the evaluation process.

Rater error training is originally a psychometric approach. The unreliability of performance assessment is attributed to rating errors and biases. In the training process the errors are described, raters are confronted with the types of errors they committed, and they are instructed on how to avoid them [19]. Typical errors are distributional errors (severity, leniency, central tendency), halo-effects (the rater fails to distinguish between the different dimensions), the similar-to-me effect (people who are perceived as similar to the rater are judged more favourably), and primacy effects (initial judgements lead to distortion or to ignoring of subsequent information so as to support the first impression).

Bernardin & Pence [20] found that RET was effective for leniency and halo-effect errors, but less effective in increasing accuracy. There are other studies which document the limited effectiveness of RET if it is the only form of training applied. A combination of different training methods is also recommended by authors like Hauenstein [21], who recommends a combination of rater accuracy training and behavioural observation training. Sulsky & Day [22] suggest the development of a training program that combines the elements of existing programs. Stamoulis & Hauenstein [23] combined elements of RET and FOR training to develop the rater invariability training (RVT).

In behavior observation training the focus is on the process of observation, on the detection, perception and recall or recognition of certain relevant aspects of behaviour. Thornton & Zorich [19] identified sources of error that are detrimental for observation accuracy, such as loss of detail because of simplification, categorisation error (observations are prematurely forced into categories, relevant
differences are lost), contextual errors, prejudice and stereotyping, among others. In this context it is also important to distinguish between automatic and controlled cognitive processes. Raters should learn to exchange automatic categorisation processes in encoding and storing information by controlled cognitive processes.

The third type of training, FOR, sustains that it is not possible to limit the role of the rater to that of simply an observer; raters are also evaluators or judges. A rater must make inferences about performance. Formats alone cannot specify everything a rater of innovation competence behaviour needs to know or to consider in order to produce valid ratings. A special kind of training is important. Instead of relying on the process of rating, which is more the focus of behavioral observation training, FOR training has a more content-oriented approach.

Frame of reference training attempts to provide raters with a frame of reference for making evaluations of the ratee’s performance. The goal is to reduce arbitrary performance standards by having raters discuss their own standards and implicit theories of performance in comparison with the normative standards to get raters to share a common perception of performance standards. Raters are trained with representative examples, videotaped vignettes, and role play situations, which present critical incidents for good, average and poor performance. Raters receive and discuss in training feedback on the discrepancies between their ratings and the target scores.

Studies of frame of reference training (FOR) have shown significant improvements in rating accuracy [15,19,24], although not in all four components of rater accuracy formulated by Cronbach [25]. The greatest improvement was found by Stamoulis & Hauenstein [23]) in Cronbach’s differential accuracy – the ability of raters to differentiate between ratees within dimensions.

5.3 INCODE rater training

The rater training developed for the INCODE Project needs more than five hours time. The duration is due to the combination of different training models. Research, moreover, has shown that short training is ineffective and shows no consistent results [26,27]. In addition, the effects of training do not last over time [26]. In the INCODE Project we are prepared to re-train the raters or to have at least periodic re-calibrations.

However, as Myford & Wolfe [28] state, even thorough and extensive training will not guarantee that all participants understand and agree with the standards of the training. The INCODE rater training concept also includes a certification exercise in which participants must match the ratings of videos, observations or artifacts awarded by a panel of experts in order to receive certification.

6 CONCLUSION

This paper has reported on the Innovation Competency Development Project in which four universities from different European countries have joined forces to tackle the question of not only how to stimulate the acquisition of a cluster of competences that conform innovation competence but also how to assess the achievement of the objectives. INCODE proposed to complement the AHELO initiative to measure certain generic competences in writing by taking on the assessment of oral performance of students in given situations embedded with R&D+i and active learning methods.

INCODE has produced an Innovation Competence Barometer with three dimensions. The cluster of capacities and skills contained in innovation competence are divided into an individual, an interpersonal and a networking dimension. After substantial revision, the instrument is now being field tested at the four partner universities, primarily in what are called Research Hatcheries.

Quantitative and qualitative analysis will validate the instrument and shed light on the usefulness of the learning methodology. INCODE will complete its work by designing the rater training that will aid in the use and application of the instrument.

ACKNOWLEDGEMENTS

This paper has been written with financial support from the European Union within the Project 518132-LLP-1-2011-1-FI-ERASMUS-FEXI "INCODE- Innovation Competencies Development".
REFERENCES


