

Structure of Doctoral Students' Research Competences in Sustainability Context

I. Bolgzda, E. Olehnovica

Abstract—Qualification of doctoral students' and the candidates for a scientific degree is evaluated by the ability to solve scientific ideas in an innovative way, consequently, being a potential of research and science they play a significant role in the sustainability context of the society. The article deals with the analysis of the results of the pilot project, the aim of which has been to study the structure of doctoral students' research competences in the sustainability context. With the existence of variety of theories on research competence development, their analysis focuses on the attained aim approach. Three competence groups have been identified in this study: informative, communicative and instrumental. Within the study the doctoral students and candidates for a scientific degree (N=64) made their self-assessment of research competences. The study results depict their present research competence development level and its dynamics according to the aim to attain.

Keywords—competence structure, doctoral students, research activity, sustainability.

I. INTRODUCTION

THE conclusive stage of higher education – doctoral studies, is closely connected with education and science in a single field, describing the needs and philosophy of aims of the society. In the 21st post-modern century, one can see serious changes and restructuring from consumer to sustainability development philosophy. Sustained development is value-oriented, its roots are in social responsibility, towards the future, integrative approach, where knowledge, research and innovation are the main driving forces of the development. In this context the issues on doctoral students' research competences and research potential are becoming especially topical.

Doctoral students' research competences are in causal relationship with the result of research, therefore its structure is made by the necessity to achieve a certain result, and the way how to achieve the aim.

Criteria of PhD qualification are determined by education standards and qualification framework, while the scientific theories of competences depict the inner context of these criteria.

In Europe the future scientists' qualification criteria are determined by European Qualification Framework (EQF), which says that as a result of studies, one must acquire innovative, autonomous and holistic professional integrity and make sustained contribution in the development of new ideas in the context of research and science. In the Latvian Qualification Framework these basic notions are adapted to the local context.

I.Bolgzda is a student's of doctoral study programme „Pedagogy” in Daugavpils University, Latvia (e-mail: ingrida-bolgzda@inbox.lv)

E.Olehnovica is senior researcher in Institute of Sustainable Education in Daugavpils University, Latvia (e-mail: eridiana.olehnovica@du.lv)

In scientific literature the competences, by their contextual similarity, using different approaches, are classified in bigger clusters. The authors of the study summarized the most characteristic principles of competence structures: process approach [1], personality actualization [4], career type or professional context [5], historically determined national tradition [2], general and specific principle [9], compilation of various systems [8]-[10].

The analysis of theories of competence structure proves that they are not mutually exclusive, at the same time there is a tendency for them to expand and deepen, that's why the emphasis in the study is put on the attained aim context, or sustainability principles and their manifestation in the research competence structure, which is centered around three sustainability principles: holistic approach, anticipation of changes, prognosing; ability to put these changes into life. These three principles are intervening all innovative research stages and the levels of research competence development.

The empirical part of the study is based on F.E.Weinert's competence system approach [10], emphasizing the model „competence-result”, as well as European Education structure project TUNING in classification of competences [9]. The mentioned approaches are chosen in order the research competences would analyze the aim or attaining of the sustained research result. Their preconditions are the understanding of changes and the ways of their implementation, besides, doing it in cooperation with others. Relying on sustainability principles and theories focussed on aim-attaining competences, the authors classify the doctoral students' competences as follows: informative, instrumental and communicative. Such a classification allows to interpret doctoral students' research competences also as the basic activities of research: to feel; to think; to act.

Interrelationships of sustainability principles, basic research activities and competence classifications make the research methodology:

- holistic approach ↔ to feel ↔ communicative and informative competences ;

Holistic approach at the initial stage of research is exposed as the ability sensitively to observe wide interrelationships, alternative ideas, intuitively imaging the result prior to us having any knowledge about it [6]. Later the problem solutions change from image into understanding and choice of strategy, which in the study is summarized in the group of informative competences. Here communicative competences are of importance, because one must believe in oneself first of all and then persuade others about the result planned. Interrelationship in sustainability philosophy is especially stressed, therefore in communicative competences there should be included also the ability to cooperate and participate.

- anticipation of changes and prognosing ↔ to think ↔ informative competences;

In the 21st century, with the existence of overabundance of information, quality of knowledge is more essential than its quantity, therefore the most significant in doctoral students' research will be the skill to assimilate the known and to integrate it in different contexts. Integrative approach in sustained research is an essential competence in order to prognose and anticipate. Excessive concentration on the knowledge in a single field can create a „tunnel view” [3].

Informative competences depict the main activity of research – to think. Thinking is connected with research cognition which is markedly purposeful type of cognition, or intensive depiction of new relations, which calls for sufficient previous preparedness. Evaluation of the relationship requires analytically critical thinking which would be autonomous and independent, free from dogmatism, prejudices and stereotypes. In this competence cluster there are included a lot of a researcher's personality traits and the intellect in order to identify the problems, to collect and analyze the information, to find alternative ideas, to synthesize and to evaluate [7].

- to implement changes ↔ to act ↔ instrumental competences;

Implementation of changes is the action that approves the skill and readiness to act. Activity competences can analyze a certain personality trait or knowledge level of professional research instruments. In the study the emphasis is put on the ability to process and analyze the research data, because to implement changes or to introduce innovations if based on incorrect data is not good scientific practice. Instrumental competences developed from such an aspect are the preconditions for a doctoral students' research or scientific innovation to be grounded.

The mentioned basic research activities – to feel, to think, to act, and the research activity competences do not develop and do not form lineary, they are constantly intervening and supplementing each other.

II. RESEARCH METHODOLOGY

A pilot study was carried out at Daugavpils University (Latvia), questioning doctoral students and candidates for a scientific degree (N=64) of various study programmes and study years. The questionnaire had included the most essential competences which are necessary for a doctoral student and a candidate for a scientific degree in order he/she would successfully do research work. The chosen competences characterized basic research activities: to understand the research problem, to think, to do and to answer the questions: what? how? In what way?

Respondents did self-assessment of 38 research activities-informative (knowledge included, adaptation of experience and integration, as well as critical analysis in the context of competence research aim and research sensitivity), communicative (includes abilities to involve and participate in the research environment) and instrumental competence (includes competences which characterize purposeful, practical activity and skills to process, interpret research data) in 5 point score. Each point in the score determines the competence development level in %: 1 point – 0%; 2 points –

25%, 3 points – 50%, 4 points – 75%, 5 points – 100%. Such an approach allows to find out which competences are considered by the respondents as essential in the research work, and to what extent they are improved.

The development of research activity competences is a dynamic process, the competence level may be different in different study stages, therefore the competence levels were compared in two selections: doctoral student/candidate for a scientific degree.

For the data processing there were used the factor analysis and cluster analysis, which allow to group and cross-check two selections – doctoral student/candidate for a scientific degree and to state the competence development level in each of these groups.

The authors of the study, considering the scientific analysis of competence theories, classified the research activities into three groups: informative competences (F1); communicative competences (F2); instrumental competences (F3).

III. ANALYSIS OF RESEARCH RESULTS

Research activity competence factors were grouped into three groups, showing different level of importance. Intervals of the factor weight was made by the amplitude: F1 from .402 till .757; F2 from .413 till .686 and F3 from .404 till .682. Statistically significant level between two selections is considered to be, if the factor weight is < 0,05. The data show a statistically significant difference between the factor groups.

TABLE I
FACTOR ANALYSIS OF COMPETENCE GROUPS

	Doctoral Students' Self-assessment (factor weight)	Self-assessment of a Candidate for a Scientific Degree (factor weight)
informative competences (F1)	-0.33	0.33
communicative competences (F2)	0.12	-0.12
instrumental competences (F3)	-0.06	0.06

Comparing the development level of the three mentioned research activity competences in the respondent groups, we have to mention that the candidates for a scientific degree demonstrate a higher informative and instrumental competence development level for the doctoral students which is logical because the competences are improving in the study process, alongside with the advancement of research experience. However, if the competences are poorly developed in the initial stage of research activity, then the knowledge assimilation and adaptation in solution of certain research problems will not be good. But the low level of competence proportion of the candidates for a scientific degree includes certain risks for the ability successfully integrate in professional research environment. Although there exists the difference between a doctoral student and a candidate for a scientific degree in their instrumental competence development level, it is, in general, evaluated as low.

During research data processing, respondents were included into three cluster groups considering three signs (F1, F2, F3) : 1st group – low self-esteem; 2nd group – moderate level self-esteem; 3rd group – high self-esteem. Summarizing the results, NF1 group – low (result – 39.1 %), NF2 – moderate (result – 32,8 %) and NF3 – high (result -28,1 %) competence development level. High competence evaluation form the smallest percentage cluster, there dominates moderate research activity competence level assessment. By evaluating the competence groups (see, TABLE II), we can conclude that in the highest cluster group all doctoral students' research activity competence groups develop rather equally, but in the respondents' answers in the moderate cluster group one can see a great range of amplitude between the informative and instrumental competence group development levels, which similarly like a factor pendulum, shows insufficient knowledge of professional research instruments. It is worth mentioning, that part of respondents show also a low measure in informative competences.

TABLE II
CLUSTER ANALYSIS OF COMPETENCE GROUPS

	1st Cluster Group low evaluation	2nd Cluster Group moderate evaluation	3rd Cluster Group high evaluation
NF1-informative competences	-0.886	0.36	0.811
NF2-communicative competences	-0.238	-0.185	0.547
NF3-instrumental competences	0.205	-0.73	0.567

We have to conclude that respondents' uneven development of research activity informative and instrumental competence groups include in itself the risk factor – ability to direct one's knowledge and thinking skills towards the practical result and valid interpretation of research data.

Respondents' cluster with the lowest research activity informative competence self-esteem level is, perhaps, difficult to describe and ground one's research structure, because in this competence group there were included such competences as research sensitivity and critical thinking which are indispensable in sustained research. There is an evident interrelationship – the higher is the research activity informative competence measurement, the more effective is scientific communication. Evidently, in order to successfully cooperate in research environment, one has sufficiently well know the subject of scientific interests.

Using the before-mentioned cluster groups, the necessary competence development level needed for research, was analyzed in the aspect - doctoral student/candidate for a scientific degree.

TABLE III
CLUSTER ANALYSIS OF COMPETENCE GROUPS: DOCTORAL STUDENTS AND CANDIDATES FOR A SCIENTIFIC DEGREE

	Doctoral Students' Self-esteem %	Self-esteem of Candidates for a Scientific Degree %
Low self-esteem (NF)	53.13%- instrumental competences (NF3)	25% - informative competences (NF1)
Moderate self-esteem (NF)	28.13%- communicative competences (NF2)	28.13% - communicative competences (NF2)
High self-esteem (NF)	18.75%- informative competences (NF1)	46.88% - instrumental competences (NF3)

Doctoral students, when doing the self-assessment of their research activity competence development level, emphasize the informative competences, but candidates for a scientific degree- instrumental competences. At the initial stage of research activity, respondents consider that it is more essential to learn the study subject, by concentrating on the question – what?, while the question – how to do it? (instrumental competence) is more essential to candidates for a scientific degree. The results of the study prove that the dynamics of research activity informative competence development is very slow, but for communicative competences it remains unchanged. In order the research cycle were effective, both informative and instrumental competences should improve harmoniously, because the basic research activities – to think and – to act are mutually closely connected. Unchangeability of communicative competence level gives evidence to scientific ideas, insufficient thinking, which is contrary to the sustainability principle in scientific cooperation in a single research environment.

IV. CONCLUSIONS OF THE STUDY AND DISCUSSION

Doctoral students' research aims and the corresponding research competences, considering the topicality and statements of knowledgeable society, have to be analyzed in the sustainability context. The analysis of the competence theories allows us to conclude that sustainability of doctoral students' research activities (holistic approach, prognosing of changes and abilities to realize them) have to be viewed holistically, including a broad spectre of research activity competences. The emphasis of the pilot study was put on specific, characteristic research competences, therefore holistic approach in this research stage was not achieved to a full extent.

The greatest increase in the development level of research activity competences was observed in the group informative and instrumental competences, which is grounded, because by advancing of research experience, there increases the doctoral students' ability to view the study object from various points of views and there increases the understanding on the research data interpretation. One has to say that doctoral students are weakest at instrumental competences, as well as there is seen the communicative competence level stagnation. Although doctoral students' mobility and cooperation are emphasized in the documents of education policy, in practice there exists objective (financial possibilities, different cultural and education traditions, competition) and subjective

(psychological reasons – individuality, language barrier, etc.) obstacles in order to implement it to a full extent. In the analysis of competence theories one can see close interrelationships between various competence groups, each separate competence supplements and encourages other competence improvement, however, the data of the study done on informative, communicative and instrumental competence development dynamics prove, that the improvement process is not sufficiently effective and mutually harmonized. The study updates mobility, promotion of scientific cooperation of doctoral students and candidates for a scientific degree at the national and international levels, in order to activate the exchange of various scientific ideas and integration, providing the result of sustained research activity. Results of the study do not give a unequivocal answer to the question „Is the level of research competences of doctoral students sufficient to correspond to the challenges of sustainability development in research?“, because perfection of research activity competences is a permanent process, though it is essential to identify disharmonizing aspects in the process of competence development timely.

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