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Jānis Kapenieks

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Summary of a Doctoral Thesis

for obtaining a Doctoral Degree in Pedagogy
Sub–Field: Higher Education Pedagogy

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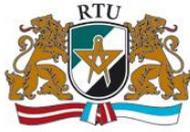
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Scientific Supervisor:
Dr.paed., professor Ilga Salīte

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The doctoral thesis has been prepared at the Distance Education Study Centre of the Faculty of Electronics and Telecommunications of Riga Technical University from 2008 to 2012.

The form of the work: doctoral thesis in the field of pedagogy, sub–field higher education pedagogy

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The doctoral thesis and its summary is available at the library of Liepāja University in Liepāja, Lielā street 14

Chairperson of the Promotion Council of Pedagogy of Liepāja University

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Contents

ABSTRACT

Jānis Kapenieks' doctoral thesis *Educational Action Research in an E–Learning Environment* has been worked out at the Distance Education Study Centre of the Faculty of Electronics and Telecommunications of Riga Technical University within the doctoral programme *E–Study Technologies and Management* as a transdisciplinary research work for obtaining a doctoral degree in higher education pedagogy.

The doctoral thesis has 227 pages, it contains 95 figures and 22 tables, as well as 26 annexes. 194 scientific sources have been used in elaborating the doctoral thesis.

The objective of the research described in the doctoral thesis is to develop a methodology for the use of action research for educational purposes in an e–learning environment and provide a model for such an environment in order to promote the sustainability of the pedagogic process.

In order to reach the objective of such a research, three basic research problems have been solved:

1. How to integrate educational action research (EAR) into an e–learning environment using the available IT resources? How to take advantage of the dual nature of action research — as a study method and a strategy for creating new knowledge — for mastering the study courses at higher education institutions?

2. How does the action research method influence the students? Does the development of the students' creativity, interests and values answer the needs of highly demanded knowledge–based professions?

3. How to create an environment design suitable for action research and what kind of e–learning environment prototype should be used for acquiring the study courses at higher education institutions? What basic principles of group work should be used in an e–learning environment?

In order to reach the objective of the research, the following tasks have been performed:

- The philosophic, pedagogic and e–learning aspects of computer science literature have been analysed. Literature on the essential aspects of action research, its use for creating personal knowledge and deepening the research participants' understanding of the research subject, the use of information technologies for acquiring knowledge and collaborative learning have been studied in depth.

- Research on professions necessary in the European countries in the future and skills and personal qualities involving interests, values and creativity that they will require have been analysed.

- A version of educational action research for the use of available internet resources and the creation of an e–learning environment has been elaborated and the results of mastering and generating knowledge in this environment have been investigated.

- The impact of educational action research in an e–learning environment on the interests and values of the students has been studied. Their adequacy to the requirements of the European labour market has been assessed.
- The shortcomings of the e–learning environment used have been identified and a prototype of an improved e–learning environment for educational action research has been developed.

The research object is the pedagogic process in an e–learning environment at higher education institutions.

The research subject is the use of educational action research in developing an e–learning environment prototype.

The described research in the doctoral thesis contains three chapters which correspond to the three outlined research problems. The research work ends with conclusions and recommendations for using the research results at higher education institutions.

GENERAL CHARACTERISTICS OF THE DOCTORAL THESIS

1. The topicality and the theoretical significance of the research

From a philosophical perspective, up to now the Western global paradigm has been based on a fragmented or divided world, in which the material world is separated from the mind and the psychic reality creates a gap between man and nature. It views the world as inert, aimless and senseless. At present, all schools of philosophy speak of the emergence of a new global paradigm, in which all people are participants of shared research (Reason, 2008). E. Lazslo (1995) sees evolution in human consciousness and the philosophic thought — a change in the way of thinking is actually a change of a paradigm. The dominant way of thinking is being currently ousted by a holistic way of thinking — and it is happening at a time when the dictatorial regimes in the world are replaced by regimes involving vast layers of society. The anthropocentric way of thinking is succeeded by humanism as a component of a sustainable biosphere, eurocentrism is followed by a diversity of cultures and societies, fragmentation (atomism) is replaced by the recognition of unity in the social world and nature. The holistic way of thinking views materialism as a an option and spontaneity. The immoderate waste of resources in the name of social progress and people's wellbeing, is replaced by a search for sustainability and balance in the biosphere and the ecosphere. In society and economics, the hypertrophic accumulation of material goods and overuse of technologies spurred on by lust for power and competition is substituted by a holistic interpretation of and emphasis on the significance of information and education, on the advantages of communication and human services over control of man and nature. Globalization and hierarchies characterized by blind submission are replaced by globally oriented cooperation (Laszlo, 1995).

One of the global paradigms is *knowledge society*. The paradigm of knowledge society directly influences the development of research in many fields, including the science of pedagogy and research of information and communication technologies (ICT).

The concept of **knowledge society** was first used by P. Drucker in 1969. He considers that we live in an age of radical changes marked by passing over from capitalism to knowledge society. In the post–capitalist era, knowledge has become the paramount resource and the leading social group, to his mind, will be *knowledge workers*. P. Drucker considers knowledge the most important resource of the new society. In knowledge society, productivity is a social and economic priority. For him, the concepts of productivity and innovation are the results of using knowledge in practice (Drucker, 1993).

As early as 1976, D. Bell predicted that in the post–industrial era, the economy of goods would develop into an economy of information. This idea gave rise to the concept of information society whose main feature is theoretical knowledge (Bell, 1976). This concept became especially topical in the nineties of the previous century

when a high level world wide web was formed and information and communication technologies developed. At the end of the nineties, the term of knowledge society replaced the term of information society in the academic circles. This term was adopted by the UN agency UNESCO expanding its meaning beyond mere economic use. While the concept of information society is associated with technological innovations, the concept of *knowledge society* involves social, cultural, economic, political and institutional changes. Knowledge develops all layers of society (Burch, 2005) and the changes are a sign of a new paradigm. The main features of knowledge society are multiple possibilities, freedom of opinion and the right to participate (UNESCO, 2005). J. Bērziņš attributes the concept of knowledge society to development which results in a higher standard of living. From an individual perspective, it is the result of a subjective view of the world determined by a personal perception of reality, taking into account the fact that each person's interaction with the environment is unique and is based on personal views, experience and the individual's character (Bērziņš, 2009).

The change of paradigms causes also essential changes in education. The present education tradition has been created during several centuries and in various economic situations. The greatest impact on its evolution was made by the industrial era and its economic imperative. K.Robinsons considers that educational systems have been formed in the interests of industrialisation and serve man's accommodation to the needs of industrial society. Schools function like factory assembly lines, producing uniform goods. The students' knowledge is checked in standardised tests. The most important parameter of the product characterising its usability is the date of its production. This model lies at the basis of society's stratification into the academic group (the wise people) and non-academic group (not so wise people). According to the education model of the industrial era, the evolution of society is determined by its economic and intellectual power (Robinson, 2011b).

Today, the concept of knowledge society is inseparable from the concept of *learning society* — a new model of society, in which the former limitations when the study place and time were determined by the institutions of the *system* do not apply any more. They have been replaced by personal responsibility for one's education and its management (UNESCO, 2005). S. Ranson has identified several aspects of the learning society (Ranson, 1998):

- It is a society which learns about itself and how it is changing;
- It is a society which needs to change the way it learns;
- It is a society in which all its members are learning;
- It is a society which learns to democratically change the conditions of learning.

In the development of the idea of the *learning society,* S.Ranson distinguishes two periods (Ranson, 1998), both are characterized by a search of meaning in a period of transition. The first period started in the Seventies of the Twentieth century and the second period started in the Nineties. S.Ranson characterises the first period as a period of learning about society which is undergoing a change. The central issue of

the second period is learning as the only means of achieving well–being in a situation in which the country has lost stability and is experiencing a change of views on occupations, religions, organisations and value systems. D. Schon holds the view that crises recur so frequently because society is not ready for changing situations. Thus, the purpose of education is preparing people for changes and transformations and discarding old stereotypes about the stable state (Schon, 1971). The most important changes in education are the concept of lifelong learning, accessibility, search for meaning in formal education and new technological solutions (Husen, 1974).

In *the learning society* model, innovations in education remove the boundaries between formal and informal education. It is evidenced by the increase of technology–based communication of society in the social networks, the vast use of open–source software, disruptive innovations within the framework of the current educational systems (CISCO, 2010). The potentialities of the technologies and people's new needs in their move towards knowledge society are at the basis of the rapid development of e–learning. The learning society model is developing side by side with the globalisation of education. It is determined by the global character of the technologies and the web, the globalisation of economy as well as people's migration (Spring, 2009). One of the most important strategic objectives of the European Union is the implementation of this model of society changing the approach to education and its quality, accessibility and social inclusion (European Commission, 1995).

H. Van Der Zee considers that for the formation of a *learning* society, it is necessary to broaden our understanding of the concept of education, lending it a societal dimension. He considers that perfection could be reached if society had the following objectives: to enhance collective competence beyond the limits of learning and instruction, encouraging self–education and autonomy in learning. *Autonomous learning* is a process, the research of which is connected with the use of the ICT and the increase of personal responsibility. It lies at the basis of *the right to learn* which should become a dominant political approach (Van Der Zee, 2006). Learning as a way of reaching perfection means learning according to true values (Hirsch, 1988), avoiding one–sided views, obsolete theories, absurd skills and other learning „accomplishments" which John Dewey called "*mislearning*". The change of a paradigm in education requires a holistic transformation of the school structure (Selinger 2008), it asks for disruptive innovations and the cooperation of all parties involved in education in order to develop creativity (Ferrari, 2009).

The paradigm of knowledge society has synergies with the development of information and communication technologies. Like book printing which 500 years ago changed education, the current vast use of digital technologies creates new challenges for education. Scientists of many fields must cooperate in order to create new products for knowledge society in which education is characterised by personalisation, effectiveness and all–embracing lifelong accessibility. Knowledge society requires a new approach to the resources of the learning process.

The most important cooperation task for researchers in the field of pedagogy and the ICT scientists is to identify the objectives to be achieved and apply the created ICT instruments for the needs of the knowledge society.

The ICT provide access to an immense amount of information which requires new competences for assessing it. The use of information technologies satisfies the main needs of 21st century education — personalisation, conformity to a person's needs, and the efficiency and effectiveness of education (Salmon, 2002). The technologies have a crucial role in students' lives, they make the learning environment innovative and creative. The skills of the students and the academic personnel supported by educational systems which are based on the new technologies create a new learning culture oriented towards the needs of the learners (Ferrari, 2009). The level of interaction skills with the new technologies often determine the ways of acquiring knowledge and personalisation (Ala-Mutka, 2008). The new generation develops in a technology pervaded environment. This generation is often alluded to as the *NetGen* or the *Google Generation* (Herold, 2009). Its creativity manifests itself in the use of the ICT: blogs, social networks, multimedia sharing applications and online games. These are the tools with the help of which the young people learn to learn, constituting, according to C. Rogers, one of the essential components of creativity (Rogers, 1983). The new ICT applications have transformed the modes of acquiring and generating knowledge. Collaboration in local communities is replaced by collaboration in kindred interest communities (Bess, 2002). The development of collaborative practice stimulates new directions in pedagogy and poses the question — what does learning mean today and how to avoid *offering yesterday's education to the young people of the future* (Prensky, 2005; Loveless, 2007). A. Loveless holds the view that interaction with the technologies is determined by the users' understanding of the technological possibilities. He calls this level „active learning process" (Loveless, 2008). It enhances the learning potential, and creates new ways of shared problem solving and knowledge construction.

Creativity lies at the basis of the new education paradigm, generating new original value–oriented ideas grounded in divergent thinking (Cohen, 1999) and collaboration (Robinson, 2011b). The research attempts to find new ways of sparking off the students' creativity at a time when the modern information and communication technologies have entered people's work, studies and everyday life. The concept of *creativity* in pedagogy differs from that of information and communication technologies. The emergence of the knowledge paradigm has motivated deeper studies of its charactertistic features. One of the issues combining the interests of e–learning, the use of the technologies and the organisation of studies is the phenomenon of creativity and its research. The knowledge paradigm is based on the use of this phenomenon. Research in pedagogy has a long–standing history and is closely linked with research in psychology and sociology. Creativity is viewed as a component of man's sustainable inner development in connection with his/her professional activities. The information and communication technologies have experienced a very rapid development within a few decades. E–learning is oriented towards acquiring the knowledge and skills which are necessary at the current moment.

The evolution of the education paradigm and its focus on creativity has motivated the author of the present paper to choose the elaboration of a methodology for the

development of a sustainable educational process as the main objective of research. The paradigm of knowledge society has made us address the issue of generating knowledge in action research, therefore the doctoral thesis is directed towards finding the link between acquiring and constructing ICT–based knowledge and the latest scientific opinions in pedagogy. Proceeding from this, the conditions for organising creative learning activities and the use of action research in creative learning activities are investigated.

The current unlimited information wealth provides the possibility to create the necessary knowledge appropriate for the present–day situation. Education faces new challenges today — to acquire knowledge generation skills. It poses new demands for teachers and instructors and requires new tools for acquiring knowledge. The demands set for teachers correspond to John Dewey's philosophy of education principle according to which the teacher's mission lies in motivating his students to acquire knowledge (Dewey, 1916). Also the ICT resources involved in the study process gain a special meaning — from the point of view of L. Vygotsky's activity theory which is rooted in his cultural–historical psychology, the internalisation and externalisation of the cognitive processes take place with the help of tools and represent purposeful interaction of the subject with the object. These tools embody the mental processes and manifest themselves in physical or psychological constructs (Kaptelinin, 1999).

One of the most advanced approaches to new knowledge generation is *action research*. Its methodology has been developed for quite a long period and it has proved to have an educational effect on people involved in it (Herington, 2008; Keiny, 2008; Dick ,2009; Whitehead, 2009). Action research (AR) is well suited for identifying any development problems of society and looking for solutions. A significant gain in this process is the obtained knowledge and the educational effect. This approach is especially valuable nowadays when nations and communities face dramatic changes caused by the implementation of the modern technologies and transformations in economy (Stringer, 2008). In order to address these problems, new approaches to the elaboration of e–learning courses and their use in education are being sought as they provide new skills and competences for solving complicated problems in real life.

The choice of the research theme has been determined by several objective contradictions caused by the paradigm of knowledge society (Cakula, 2001):

- between the intellectual and physical potentialities of an individual and the available resources;
- between an individual's natural striving for independent acquisition of knowledge and the dominant learning methods at schools and universities;
- between the vast amount of available information, which may lead to superficiality, and the need for high professional competence and skills.

These contradictions pose new educational tasks — to impart to the pupils and students the ability to orient themselves in a great amount of information, to develop the skills to use the selected information in creative activities, to develop and master

the cognitive possibilities and the metacognitive skills of the ICT (Cakula, 2001). These requirements have been included into Latvia's strategic development documents. In order to ensure the compliance of education quality to the growing demands of present–day society and economy, the Latvian National Development Plan for 2007–2013 establishes that the study process has to be oriented toward independent acquisition of knowledge and the ability to use it achieving a vast application of knowledge to any sphere of human activities. Debates in society show that this issue will gain even more weight in the new National Development Plan. According to the paradigm of knowledge society, knowledge has to becoma a national strategic treasure and its main resource for growth. To achieve it, one of the main tasks is the development of the e–resources and enhancement of their use, as well as the perfection of the skills of information technologies at all levels (RAPLM, 2006). In addressing these tasks, there is still much to do, and the new National Development Plan is expected to pay special attention to them. In the draft of the Plan, the concept of knowledge society has been with good reason substituted by the concept of *smart society*. This approach stresses the ability to generate new knowledge by learning activities.

The research of the development of knowledge society closely linked with the development of modern information and communication technologies determines its transdisciplinary nature. The research embraces the basic views of the science of pedagogy accumulated over centuries and the conclusions of ICT research conducted in the last decades. That is why special attention has been paid to terms used in both fields of science which may have a different interpretation.

One of the terms having a different meaning in the fields of the ICT and pedagogy is a prototype. ***The prototype*** does not involve all possible facts but forms a mental model (Haas, 2010). In the field of the ICT it is often used to denote the demonstration version of a new system which is used to find out the principles of information, its organisation and design (PCmag.com, 1981-2012). In the science of pedagogy, several authors use this concept in analysing educational policy as the basic means of understanding the conceptual structures of higher education — how we perceive, feel about and understand university and college level education (Haas, 2010). Most often we use prototypes unconsciously, trying to comprehend the whole system (Lakoff, 2002). Prototypes are formed from our direct or indirect experience (Haas, 2010), they express the main concepts embodying their most essential features and discarding the inessential features (Murphy, 2002; Prinz, 2002). Deciding on pursuing a definite higher education policy, prototypical thinking is used which involves unconscious reactions and unconscious perception. Prototypes are important since they are formed in social interaction, they are often difficult to formulate, they are based on experience and the type of perception, they create a positive feedback — when we think of a prototype we look at the world through it and feel comfortable with it. Prototypical thinking is often opposed to defining concepts which is characteristic of the Western way of thinking. J. Kaplinsky considers that it is impossible to define everyday concepts according to Aristotle's views. Aristotle's definitions are limiting, they define a body having clear outlines. Defining through a

prototype, a list of the most important features of the concept are provided, it is defined using the bottom–up principle. The boundaries of a prototype definition are vague and changeable (Kaplinsky, 2001).*Prototypical thinking* in problem solution corresponds essentially to action research. It evolves from the experience of an individual in contrast to the way of thinking based on previously defined concepts. This problem solving type is open to complements based on new experience whose features are added to the prototype.

With the change of the global paradigm of education, society's conception of education changes, too. The ICT bring new experience to the conception of the knowledge society paradigm influencing the prototypes of the educational system. In this case, the prototype of the e–learning environment is no more a demonstration version of definite functions. It obtains a new meaning which changes with the new experience in the e–learning environment. Therefore the elaborated prototype of the e–learning environment is at the same time part of the prototype of the educational system in the development process of knowledge society.

2. General survey of the research

The doctoral thesis embodies an instance of implementing educational action research in an e–learning environment. As a framework for researching this issue, a more extensive philosophic, theoretical and methodological basis has been employed. The philosophic background has been used in order to analyse the transition from the paradigm of *industrial society* to the paradigm of *knowledge society*. In the course of the research, methodology for using action research in creating new knowledge through learning and research involving the research participants as well as through reflection initiated in collaborative e–learning has been developed. Action research is traditionally associated with global and sustainable objectives, it tries to eliminate the traditional strictly defined disciplinary boundaries, challenging their future development. The research has been performed at a time when the development of society is entering a new *holistic paradigm*, creating changes and causing challenges in education.

The research object: The pedagogic process in an e–learning environment at higher education institutions.

The research subject: The use of educational action research (EAR) in developing an e–learning environment prototype.

The research objective: To elaborate a methodology for implementing educational action research in an e–learning environment and to create an e–learning environment prototype for enhancing the sustainability of the pedagogic process in higher education.

The research questions:

1. How to integrate the educational action research into the e–learning environment using the available IT resources? How to use the dual nature of

action research — as a study method and as a strategy for creating new knowledge — for implementing the study courses at higher education institutions?

2. How does the action research method influence the students? Does the development of the students' creativity, interests and values answer the needs of the future knowledge–based professions?

3. How to create an environment design suitable for educational action research and what kind of e–learning environment prototype should be used for mastering the study courses at higher education institutions? What basic principles of group work should be used in an e–learning environment?

In order to answer these questions, the following tasks have been performed:

- The philosophic, pedagogic and e–learning aspects of computer science literature have been analysed. Literature on the essential features of action research, its use for creating personal knowledge and deepening the research participants' understanding of the research subject, the use of information technologies for acquiring knowledge and collaborative learning have been studied in depth;

- Research on professions which will be in demand in European countries in the future and the necessary skills and personal qualities involving interests, values and creativity have been appraised;

- Relevant methodology has been elaborated and educational action research in an e–learning environment using open source internet resources has been carried out and the adequacy of the environment to the needs of EAR has been assessed;

- The results of knowledge acquisition and generation have been analysed;

- The impact of educational action research in an e–learning environment on the interests and values of the students has been studied. The adequacy of the students' development for enhancing their competitiveness (sustainability) in the European labour market has been assessed.

- The shortcomings of the e–learning environment used have been identified and a prototype of an improved e–learning environment for educational action research has been developed. Based on the experience gained, new group work principles for the use of an e–learning environment interface have been defined.

The theoretical and methodological basis of the research

The research contains three frameworks: (1) the framework of the paradigm determined by the transition of society from the industrial paradigm to that of knowledge society; (2) the framework of creativity as a significant component of the new education paradigm, and (3) the transdisciplinary framework which creates a link between the latest scientific findings in pedagogy and research in the field of information and communication technologies.

The study is based on the constructivist learning theory of Jean Piaget who holds that people construct knowledge out of the interaction of experience and new ideas. C. Owen's knowledge creation and accumulation model is rooted in J. Piaget's

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approach. The theory of the learning environment is based on J. Dewey's philosophy which has been further developed by D. Hansen and the holistic theories.

The theoretical basis of the study is the education philosophy of the American philosopher, psychologist and education reformer John Dewey which foreshadowed action research. The educational action research theory which has been developed in the doctoral thesis is based on the theoretical studies of K.Lewin, B. Dick and other followers of J. Dewey. A significant component of the theoretical basis of the thesis are the theoretical studies of B. Glaser and A. Strauss – the developers of the grounded theory and methodology which are rooted in data and differ from the traditional research methods. J. Whitehead suggested that the grounded theory should be included into action research and developed the idea of the grounded theory into a living theory rooted in phenomenology — in subjective perception, experience and reaction. The grounded theories and the living theories are practical theories, the possibilities of including them into action research for improving the existing situation have been theoretically investigated by Kevin Barge. The author of the doctoral thesis has made use also of the research of I. Salīte (Salīte, 2007) and Dz. Iliško on action research in education exhibiting a holistic approach as well as of A. Samusēviča's research (Samusēviča, 2003).

Educational action research is connected with the creativity of its participants. Its various manifestations are essential for the framework of the study. For the analysis of the creativity concept and the various aspects of its manifestations M. Runco's approach and J. Cropley's research on the relationship between creativity and adaptation have been used. The interpretation of creativity is based on J. Guilford's conception of divergent thinking and M. Kirton's theory of cognitive style. The creativity aspects have been analysed on the basis of E. P. Torrances test of creative thinking and the results of L. Almeida's, S. Freud's, M.Runco's and C.Taylor's research. In order to characterise the cognitive approach to creativity, the *Genplore* problem solving model and J. Rossmann's psychology of inventors' creative activities have been studied. The influence of an individual's interests and values on creativity has been analysed according to R. Sternberg's, T. Lubart's, S. Russ' and T. Ambaile's approach. The development of sustainable competences rooted in personal interests and values has been considered from the point of view o D. Leaonard's views.

A. Kapenieks' research on the importance of information and communication technologies in the development of the knowledge society paradigm (Kapenieks, 2009) has been also made use of. For the analysis of the cognitive processes, B. Bloom's taxonomies have been applied and compared with the theoretical studies of collaborative e–learning performed by G. Salmon which are embodied in her five–step model. J. Grundspeņķis' and A. Anohina's research on intelligent, ICT–based learning systems (Grundspeņķis, 2005), as well as I. Slaidiņš' and G. Štāle's research on e–learning solutions in education (Štāle, 2005) have been also employed.

The e–learning environment design and the interface design have been elaborated on the basis of R. Clark's and R Mayer's theories of the architecture of an e–learning environment and a user–friendly interface design enhancing the cognitive processes, which have been further developed by S. Chapnick and J. Meloy.

The author of the thesis has analysed several thousand of articles published in sectoral magazines and electronic resources in the period from 1997 to 2012.

Methods used in the research

The doctoral thesis embodies a consecutive research of the impact and results of EAR in a study semester. It attempts to find correlations by measuring the performance of the participants in EAR and comparing the parameters of its results. In order to establish causal relationships, the reasons affecting the results of the participants in EAR have been analysed. The research has been performed in learning cycles characteristic of action research the results of which allow to improve the existing situation (Geske, 2006).

Quantitative and qualitative research methods appropriate for the research subject have been applied in the thesis.

General theoretical methods. General theoretical methods have been used for the analysis of philosophical and pedagogical literature as well as the literature on e–education. These methods are at the basis of elaborating the EAR method in an e–learning environment and the assessment and comparison of the obtained results with the criteria of competitiveness in professions which will be needed in the nearest future. For the assessment of the results, the monographic method has been used.

For data collection and processing, empirical methods have been employed. The most important of them are the following.

Methods of obtaining data:
- The observation method — the students' reaction and attitude to the EAR method, their interest and activity in EAR. The impact of the method on the students' interest an activity in a longer period of time.
- In–depth interviews — the participants in EAR and experts express their views on the EAR process and its results. The experts assess the perfected architecture of the EAR e–learning environment and the user–frindliness of the interface and its adequacy to the needs and objectives of EAR. (The questions asked at the interviews can be viewed in Annexes 21 and 22).
- Content analysis — analysis of the participants' in EAR entries in the group work tables and a list of the students' innovative and creative ideas for assessing their creativity. Study of documents — for establishing the quality criteria of mastering the courses by the participants in EAR in order to use them in analysing the correlative values of EAR.
- Expert opinions — semi–structured interviews of experts on the implementation of the method, its assessment, the user–friendliness of the e–study environment and its adequacy for the cognitive process as well as the ways of using the method.

Empirical methods without direct participation of the author:
- The polling of the participants in EAR — assessment of the method, the e–learning environment, the shortcomings of the e–learning environment, the

benefits of the method, assessment of the reflection process and the generated personal knowledge, assessment of the group mates' contribution in collaborative learning.

Methods of data processing:

Mathematical–statistical data processing methods — for processing the characteristic features of the general group and the selective group and assessing the obtained results.

- Primary mathematical–statistical data processing methods directly reveal the research results, they are implemented in the *Google Docs* software tables and *MS Excel 2007* software. For greater clarity, the data have been presented in a graphical form as diagrams.
- Secondary mathematical–statistical data processing methods have been used to identify correlations which cannot be directly infered from the results of the experiments.
    - Correlations, Mann–Whitney–Wilcoxon tests and ANOVA for assessing the importance of correlations with SPSS software.
    - Hypothesis tests — deviations from the normal state for assessing the importance of the self–appraisal of the students' interests and values with *Stat Assist* software.
    - Grouping of parameters in order to describe the dynamics of the participants' in EAR interests and values.
    - Overview tables.

Research basis and selection

The research is based on students, the academic personnel and experts. The participants in EAR selected for the research were 9 groups of full-time first-year bachelor students of the Faculty of Electronics and Telecommunications of Riga Technical University doing a Business course. In the autumn semester of the 2009/2010 study year, all students were invited to participate in the research. 234 students were immatriculated in the course. 154 of them forming six academic groups had chosen the study programme "Telecommunications" and 80 students forming three academic groups had chosen the study programme "Electronics". All in all, 199 students were involved in the research. All students were expert users of the information technologies. 32 of the research participants were women and 167 were men. In the second cycle of acquiring EAR knowledge, 169 students (31 women and 138 men) were involved. In the third cycle of acquiring EAR knowledge 135 students (25 women and 110 men) were involved. After having mastered the business course, 100 students participated in the poll.

In the autumn semester of the 2010/2011 study year, 71 students of three groups — 25 electronics students from one academic group and 46 telecommunications students from two academic groups — were invited to participate in the research. From among them, 57 expressed the wish to participate — 6 women and 51 men. In the second cycle of acquiring EAR knowledge 39 students (3 women and 36 men) were involved.

In the third cycle of acquiring EAR knowledge 29 students (3 women and 26 men) were involved. After having mastered the business course, 23 students answered the poll questions.

During the whole research period, electronic communication between the students participating in EAR and the e–learning consultant was analysed.
At the end of the course, an expert who was also involved in the course answered questions in an extended semi–structured interview.The implementation of EAR in extended semi–structured interviewa was assessed by three experts — in pedagogy, e–learning and the computer science. They also performed the validation of the improved architecture of the EAR e–learning enviromnment and the interface design.
EAR in an internet environment was approbated also in an Information technologies part–time masters sudent group at Liepāja University mastering the course ”Professional Communication”. All the nine masters students performed one EAR learning cycle in the form of synchronous e–learning, using the same e–learning environment which was used by Riga Technical University students which is well suited for acquiring the Professional Communication course. The teacher also participated in the synchronous EAR course joining the group in an EAR video conference. At the end of the course, eight students participated in a poll assessing the method used.

In order to obtain expert opinions, persons highly competent in pedagogy and e–learning were invited. All experts had a positive attitude toward their task. They used the criteria recommended by Dz. Albrehta (Albrehta, 1998). The experts' coefficients of competence were determined taking into account their length of science career, which exceeds 10 years for all experts , academic degree (all experts have a doctoral degree), scientific publications, competence in organising e–learning and competence in pedagogy according to their self–appraisal. The parameters characterising each expert's competence were used for the calculation of the competence coefficient $k=a/a_{max}$, where k is the competence coefficient, a − the sum of points in all sectors, $a_{max}=5,3$ is the maximum possible sum of points. The obtained competence coefficients are the following:
1st   ekspert – 4,5
2nd   ekspert – 4,5
3rd   ekspert – 3,7
4th   ekspert – 3,7

Research limitations

A more extensive analysis of the impact of the activities of the e–learning consultant in full–time classes on the results of educational action research in an e–learning environment has not been included into the research. A more extensive analysis of the influence of the group size on the research results has not been performed, either. No analysis has been carried out of the expediency of offering educational action research in an e–learning environment to students whose computer literacy is not sufficiently high.

Stages of elaborating the doctoral thesis:

1. 2007.09.–2009.05. — Preparation of the reference system for the research. Analysis of philosophic and pedagogic literature, methodical literature on e–learning and publications on action research. Analysis of e–learning experience at Riga Technical University. Development of the theoretical basis and the methodology for an action research prototype.
2. 2009.08.–2010.12. — Implementation of action research: modelling and development of EAR methodology; incorporation of the e–learning environment architecture and design into open source resources; choice of questions for EAR and polling forms; drawing up of polling forms; observation, polling and interviewing of the participants in EAR; processing and analysis of the data obtained.
3. 2011.01.–2012.05. — Data analysis and theoretical reflection. Analysis and assessment of the EAR results; identification and analysis of the EAR participants' interests and values in the context of their competitiveness in the labour market. Search for an action research prototype on the basis of prototypical thinking. Perfection of the method by elaborating new e–learning environment architecture for EAR and a new e–learning environment prototype based on the results of the reaearch. Validation of the prototype by experts. Presentation of the research results at conferences and their publication. Formulation of the research results in a doctoral thesis.

Scientific novelty of the research

Action research can be used not only for scientific objectives. The research has proved also its essential educational merits, as a participant in EAR acquires also the experience and knowledge in reflection and generates new knowledge himself/herself, thus helping to solve the problem.

- The results of the research have shown that EAR is an effective knowledge acquisition form not only in full–time studies but also in synchronous and asynchronous e–learning. Group collaboration in an e–learning environment helps to construct and acquire knowledge. In group work, the students' performance level is comparatively equal, there are no distinct leaders doing most of the work, which is a phenomenon often witnessed in contact groups. The teacher/e–learning consultant can easily supervise and encourage the students' work in an e–learning environment without interfering into the knowledge generation process.
- A new method of assessing the EAR participants' creativity has been elaborated in the research. It allows to make several new conclusions about the correlation between the parameters characterising the students' collaboration in the group and their creativity in EAR.

- In situations in which people collaborate for educational purposes, their communication skills, based on their knowledge of human psychology and the cognitive processes, have a great importance. During the research, a computer interface stimulating the cognitive processes was developed. The research results allowed to identify several new principles of e–learning environment design for group collaboration in a synchronous and asynchronous e–learning process. These principles lie at the basis of an e–learning environment interface design which enhances the cognitive processes.
- The research outlined also several new directions for further studies. It is important to find out the effectivity of using EAR in an e–learning environment for acquiring different study courses including social and humanitarian sciences. It is advisable to continue research on the possibilities of using EAR in different target groups including comprehensive schools and lifelong learning programmes.
- Another direction offering a vast field for research is the clarification of the principles of a computer interface promoting the cognitive and metacognitive processes and the corresponding e–learning environment architecture for various educational scenarios. The use of the ICT in education has significantly extended the variety of these scenarios and prepared the way for the elaboration of new scenarios.

Practical significance of the research

The possibility of using new information technologies in the study process motivates both the teachers and the students. The creation of new and attractive learning methods turns the computer into an effective tool for developing the students' creativity, interests and knowledge. Today, the ICT are ubiquitous and the young people work with the help of a computer in an e–learning environment not only at home or in the study room, but also in public transport or in the park using a smart phone.

At the same time, the new study method gives the teacher or the e–learning consultant the possibility to effectively supervise the students' work. In large student groups, it is difficult for the teacher to follow the students' creative activities and correct them. Using the educational action research method, the students follow each other's work and suggest supplements and amendments. The teacher's task is to follow the process and assess it. It makes the study process much more effective.

The elaborated EAR method for e–learning and the improved e–learning environment prototype form the basis for a wide use of the method. The research method has been validated for practical use of the general group of students who regularly use the ICT and have mastered their application. Therefore it is necessary to verify the method and its potential adaptation for use by other target groups. The same applies to the use of EAR in mastering the humanitarian sciences. However, the

results of the research have prepared the ground for practical use and extension of the method. It belongs to the author's further pedagogical and research plans.

The research has shown that the use of EAR in e–learning helps to develop personal traits which make the participants competitive in the labour market — the method stimulates creativity which is essential in innovative activities and research. The method requires from the students the ability to follow their group mates' performance and ideas, to understand and analyse them. At the same time, it requires from them the ability to substantiate their recommendations and offer them in a benevolent and collaboration–oriented form. The method promotes collaborative skills and empathy, especially in an internet environment which currently has many shortcomings. The students widely use the internet resources for information. The EAR method develops their ability to identify valuable information in the internet and at the same time instills a critical attitude to these resources.

Recommendations for the use of EAR in e–learning at higher education institutions. EAR in an e–learning environment has provided the preconditions for developing the students' creativity. At the same time, taking advantage of the interest of the "digital generation" in the use of the ICT and the social networks, it gives new possibilities for motivating the students to acquire knowledge. In the current situation, when the academic personnel are often overloaded with work having to supervise a great number of students, student collaboration in the exchange of knowledge, experience and ideas acquires great importance. Student collaboration in an e–learning environment gives the teacher the possibility to supervise the creative activities of many students even if he/she has to analyse many innovative ideas.

EAR implemented in the research, showed that the method could be applied to create knowledge about various ideas. It is advisable to use the method in cases lending themselves to various interpretations. The living theories which the students create in EAR are such interpretations. Their creation gives the possibility to construct a discourse for expressing views on factors which have an impact on the situation and assess them, at the same time giving new knowledge. This method can be used in the courses on natural sciences in order to solve problems connected with natural processes as well as for the interpretation of processes modelled in laboratories. It is advisable to use EAR also in modelling economic processes. The computer skills of the participants in EAR have a crucial role in the successful use of the method.

The research showed that the students and the e–learning consultant perform EAR in various situations and from various terminals. The computers of Riga Technical University computer room, personal laptop computers, open access computers at libraries and mobile phones have been put to use. Such a possibility has been provided by the architecture of the system — only an internet browser is necessary for access to the e–learning environment without additional investments or an installment of a special software on the computer.

Used with the e–learning environment prototype developed within the framework of the research, the teacher's/e–learning consultant's interface complies with the principle of user–friendliness. It is convenient for forming student groups, for

reviewing the results and adding commentaries. It helps to form a positive attitude on the part of the academic staff towards the use of the method at higher education institutions.

Structure of the doctoral thesis

The research described in the doctoral thesis contains three chapters which correspond to the three basic research problems. The research thesis ends with conclusions and recommendations for using the results of the research at higher education institutions. The doctoral thesis has 230 pages, 96 figures and 22 tables as well as 26 annexes. 186 scientific sources have been used in conducting the research and elaborating the doctoral thesis.

Theses for defence

The results obtained during the research substantiate the causal relationships that have been advanced as theses for defence.
1. Educational action research in an e–learning environment is a new method for constructing and mastering knowledge. Using this method and collaborating in an e–learning environment, the students generate new ideas and creatively supplement each other's ideas by reflection in a discourse. They generalise these ideas in a living theory which gives them a new experience and new personal knowledge. A living theory is the result of prototypical thinking, it is open to supplements, and it is based on direct or indirect experience.
2. Educational action research in an e–learning environment develops the students' creativity perfecting their analytical and synthetic skills as well as their ability to convince other people of the rightness of their ideas. These skills are necessary to realise their interests oriented toward creative activities and to ensure their sustainable development.
3. Students working in a group in an e–learning environment, are not afraid to express innovative ideas creating a discourse and generating and mastering new knowledge. They are learning to accept and assess other students' ideas, including them in their own statements. In collaborative group work, there are no authoritative leaders, the students' performance level is comparatively equal. The students' creativity does not depend much on the sequence of their involvement in group work.
4. The most successful students do not create the greatest amount of new ideas. It testifies to the fact that in the current assessment system the knowledge acquired is valued more than creativity. This certainly applies to the general group of information technologies students.
5. Educational action research in an e–learning environment contributes to the competitivenes of the general group of students in professions which will be in high demand in the labour market in the nearest future. The general group consists of information technologies students. But there is good reason to

consider that it may apply also to the students of natural sciences and engineering.

6. Educational action research in an e–learning environment gives the teacher/e–learning consultant the possibility to follow and assess the creative activities of a larger number of students. Working in a group, the students themselves get acquainted with and correct the performance of their group mates. It facilitates the work of the academic staff with large student groups.

Approbation of the results of the doctoral thesis

Reports at international conferences

1. Kapenieks, J. (2012). E-learning interface for the educational action research, the 10th International JTEFS/BBCC Conference, May 22–25, Savonlinna, Finland.

2. Kapenieks, J. (2011). Knowledge creation: action research in e-learning teams, EDUCON2011 "Learning Environments and Ecosystems in Engineering Education", Amman, Jordan, April 4–6, 300 participants.

3. Kapenieks, J. (2011). Collaboration trends during action research in an e-learning environment for developing and acquiring effective personal knowledge, CSEDU 2011, the 3rd International Conference on Computer Supported Education, Nordwijkerhout, Netherlands, May 6–9, 220 participants.

4. Kapenieks, J. (2011). E-learning environment for sustainability in educational action research, the 9th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education.", Šiauliai, Lithuania, May 18–21, 180 participants.

5. Kapenieks, J. (2011). Grupu darba mācību procesa pētījumi e-studiju vidē, Mūžizglītība 21. gadsimtā. Iespējas un inovācijas (Research of group work in an e–learning environment in the study process. Lifelong education in the 21st century. opportunities and innovations). (EC project ELVIN (505740-2009-LLP-ES-KA2_KA2MP), Rīga, June 8, 40 participants.

6. Kapenieks, J. (2010). Action reserch for creating knowledge in an e-learning environment, the 8th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education", Paris, France, May 17–19, 120 participants.

7. Kapenieks, J. (2010). Empowering users by applying the action research approach in e-studies, eLBa e-learning Baltics 2010, Rostock, Germany July 1–2, 160 participants.

8. Kapenieks, J. (2009). "Mobile learning as a tool to raise competency levels", the 7th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education", Daugavpils, Latvia, May 5–8.

9. Kapenieks, J. (2008). "Context sensitive m-learning objects to correspond to content-level requirements", the 11th International Conference on Interactive Computer Aided Learning ICL2008, Villach, Austria.

10. Kapenieks, J. (2015). "E-courses on professional communication for the promotion of social inclusion" ,VI Baltic Studies Conference, Vidzeme University College, July 19.

Articles in internationally recognised magazines

1.Kapenieks, J. „E-learning Interface as an Essential Component for Educational Action Research". Journal of Teacher Education for Sustainability. ISSN 1691–4147, Accepted for publication, a document certifying it and the text of the article in Latvian has been annexed to the thesis. SCOPUS (Elsvier Bibliographic Databases) database.

2.Kapenieks, J. „Action Research for Creating Knowledge in an E-Environment". Discourse and Communication for Sustainable Education, Daugavpils University. Accepted for publication and is being edited.

Publications of full texts of reports in conference proceedings

1.Kapenieks J. (2012) E-Learning Interface for Educational Action Research. The 10th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education", Savonlinna, Finland, May 22–25. Accepted for publication and is being edited.

2.Kapenieks J. (2011) E-Learning Environment for Sustainability in Educational Action Research. The 9th International JTEFS/BBCC Conference " Sustainable Development. Culture. Education": Proceedings, Lietuva, Šiauliai, May 18–21, p. 297–319.

3.Kapenieks J. (2011) Collaboration Trends during Action Research in an E-Learning Environment for Developing and Acquiring Effective Personal Knowledge // CSEDU 2011. The 3rd International Conference on Computer Supported Education: Proceedings, Noordwijkerhout, Netherlands, May 6–9, p. 179–186.

4.Kapenieks J. (2011) Knowledge Creation: Action Research in E-Learning Teams // IEEE EDUCON 2011 "Learning Environments and Ecosystems in Engineering Education": Proceedings, Amman, Jordan, April 4–6, p. 859–864.

5.Kapenieks A., Gulbis R., Žuga B., Kapenieks J., Tomsons D. (2011) E-Learning Innovation: Cases at Riga Technical University // Proceedings of Annual International Conference "Virtual and Augmented Reality in Education (VARE 2011)", Valmiera, Latvia, March 18, p. 130–134.

6.Kapenieks J. (2010) Empowering Users by Applying the Action Research Approach in E-Studies // eLBa e-learning Baltics2010, proceedings, Rostock, Germany, July 1–2, p. 173–182.

7.Kapenieks J. (2010) Action Reserch for Creating Knowledge and Promoting Discourse in an E-Learning Environment // Proceedings of the 8th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education", Paris, France, May 17–19, p. 1–18.

8.Kapenieks J. (2009) Mobile Learning as a Tool to Raise Competency Levels. The 7th International JTEFS/BBCC Conference "Sustainable Development. Culture. Education" : Research and Implementation of Education for Sustainable Development : Proceedings, Daugavpils, Latvia, May 5–7, p. 290–310.

9.Jākobsone-Šnepste G., Strazds A., Ozoliņa A., Štāle G., Kapenieks A., Tomsons D., Kapenieks J., Znotiņa I., Hohfelde A. (2008) Using a Multimedia Game-Based Approach to Empower the Disabled and Help them Achieve their Educational

Aspirations // Amazing e-Learning II: Conference Proceedings, Bangkok, Thailand, March 7–11, p. 1–7.

10.Jirgensons M., Kapenieks J. (2008) Context Sensitive M-Learning Objects to Correspond to Content-Level Requirements . The 11th International Conference ICL 2008 Proceedings, Villach, Austria, September 24–26, p. 1–15.

11.Znotiņa I., Kapenieks A., Jākobsone-Šnepste G., Tomsons D., Hohfelde A., Kapenieks J., Štāle G., Strazds A., Ozoliņa A. (2008) Empowering the Disabled by Helping Them Achieve Their Educational Aspirations by a Multimedia Game-Based Approach. Annual Proceedings of Vidzeme of Applied Sciences "ICTE in Regional Development", Valmiera, Latvia, June 12–14, p. 83–88.

12.Kapenieks J., Trapenciere I. (2007) Web and Computer Based Courses on Professional Communication for Promotion of Social Inclusion, Conference IMCL 2007 International Conference on Interactive Mobile and Computer Aided Learning, Proceedings, Amman, Jordan, April 18–20, p. 1–10.

Other publications
1.Ozoliņa A., Žuga B., Kapenieks A., Jirgensons M., Gulbis R., Žuga D., Kapenieks J. (2010) D5.1 – Project Web Site // European Commission: RTU, p. 1–16.
2.Ozoliņa A., Žuga B., Kapenieks A., Jirgensons M., Žuga D., Kapenieks J. (2010) D5.3 – Video Presentation // European Commission: RTU, p. 1–13.

Theses for conferences
1.Kapenieks, J. (2012) E-learning interface for educational action research. The 10th International JTEFS/BBCC Conference, May 22–25, Savonlinna, Finland.

The structure, content and the main conclusions of the doctoral thesis

The results of the research provide answers to the research questions.
The instructional method of mastering knowledge in educational action research in an e–learning environment stimulates creativity and sustainable development of an individual.
- Personalised technologies develop the ability to construct personalised knowledge.
- User–oriented technologies develop the ability to obtain personal experience by reflection.
- The mobility of the technologies helps to construct contextual knowledge suitable for each situation.
- The accessibility and networks of the technologies provide the possibility to construct knowledge in a discourse by collaborating in a discussion.
- The durability of the technologies helps to achieve sustainable personal development through lifelong learning.

Educational action research helps to perfect the study process in which the students themselves construct knowledge by way of cognition and reflection. The new information and communication technologies allow to perform EAR also in the form

of e–learning. The elaborated research method gives the possibility to provide quantitative characterisation of processes connected with elusive knowledge difficult to express in words. Earlier its characterisation was largely intuitive.The e–learning environment has been designed in a way which enables quantitative characterisations. EAR performed in an e–learning environment shows that:

- Within the framework of the study course, the students are motivated to participate in EAR. They are not afraid to express innovative ideas, creating a discourse and constructing and mastering new knowledge. They learn to accept and assess other students' ideas incorporating them in their own judgements.
- The application of the new method increases the students' interest in the course to be acquired and improves their performance.
- EAR develops the students' creativity which in its stead improves their performance.
- The most creative students in EAR gain the best results in mastering the course. However, those students whose academic results are the highest are slightly less creative in EAR.

It confirms the view that the best students do not belong to those persons who create the greatest amount of new ideas.

Educational action research in an e–learning environment introduces creativity in the traditional e–learning process oriented toward problem solution by adaptation. Creativity is sustainable in contrast to adaptation which is oriented toward problem solution in the short term. It makes EAR in an e–learning environment a an element of the study practice which can support lifelong learning.

Collaboration is an essential component of EAR having a motivating and creative significance. Student group work in an e–learning environment has several nuances differing it from the work of full–time study groups in which one or two students often dominate.

- Student group work in an e–learning environment is easy to supervise and the students' performance level in the group is comparatively equal, it does not depend on the sequence of their involvement in group work. It is possible to assess each student's collaborative performance.
- Students are also motivated if they volunteer for involvement in EAR, voluntary involvement stimulates creativity.
- The students' performance and creativity in the EAR group does not depend much on the sequence of their involvement in group work. Only those students who are the last to get involved in group work manage to do slightly less.
- The students' activity is promoted by a fairly intensive work when they do not have to wait long for their group mates' reaction. The e–learning consultant's and the teacher's supervision and involvement promote the students' activity. Yet it is not advisable to interfere directly into the students' collaborative work in EAR.

The students'group work in EAR offers the possibility to assess the adequacy of the created e–learning environment. The e–learning environment has to provide user–

friendly collaboration possibilities in an internet environment to the participants in EAR. The study environment an essential part of which is the e–learning environment has a stimulating impact on EAR. The EAR algorithm corresponds to the potentialities offered by the RTU e–learning environment ORTUS and the Google documents software. The e–learning environment created within the framework of the research provides adequate functionality for EAR, though it has several shortcomings. One of them is a group work interface which does not support the cognitive processes. The requirements for the e–learning interface in EAR should be established according to Bloom's taxonomy levels in cognitive processesa and G. Salmon's five–step model for collaborative e–learning. EAR provides the possibility to identify the principles for an e–learning environment design and group work in an e–learning environment which have not been defined before in scientific literature.

It is possible to eliminate the shortcomings related to the user–friendliness of the interface design by developing it according to the principles defined in the research. The new architecture of the e–learning environment prototype elaborated within the framework of the research is based on the following functions:

- Coordination — the RTU e–learning environment ORTUS;
- Interface organisation, entry of data and their presentation — the external web server;
- Authentication — the Google account;
- Data collection and storage — Google documents.

As the environment used earlier, the environment used in the research can be accessed from any computer or smartphone with the help of an internet browser. It maintains the potentialities of the environment used earlier but its interface is more suited for cognitive processes. The new interface of the e–learning environment prototype makes it easier for the teacher/e–learning consultant to supervise the students' performance and saves his/her time and intellectual resources for analysing and correcting the students' work.

The results of the research show that new knowledge is not the only benefit of the participants in EAR. They develop also creativity which is based on their personal interests and values. In a longer period of time, EAR influences the participants' interests and values helping them to develop competences in professions which in the nearest future will be needed in the labour market. Among them, research skills rooted in creativity and the ability to take responsibility belong to the most essential competences.

The research demonstrated that EAR in an e–learning environment does not make problems for students for whom computer skills are essential and for whom the internet is accessible. The results of the research allow us conclude that the method can be applied in mastering various study courses. Its main advantage is the possibility to model comparatively complicated real life situations, the ability to take decisions and substantiate them, as well as to receive the assessment of one's performance. It deoes not require additional investments in infrastructure because it can be used from any terminal which has an internet connection. With the development of the modern ICT, the number of students using this method increases

not only in the sciences programmes but also in the social and humanitarian programmes. The academic personnel use the ICT more extensively in their everyday life and work perfecting their skills. However, a more extensive use of this method in these fields requires additional research and possibly the updating of the e–learning environment and the method used. The research essentially complies with the paradigm of knowledge society whose main value is knowledge closely related to practical action in taking decisions.

GENERAL SURVEY OF THE RESULTS OF THE RESEARCH

1. Action research, the study environment, the e–learning environment

1.1 Action research as a method of acquiring and generating knowledge

Chapter one gives an answer to the first research question: How to integrate the educational action research (EAR) into an e–learning environment using the available IT resources? How to take advantage of the dual nature of action research — as a study method and a strategy for creating new knowledge — for mastering the study courses at higher education institutions? The history of the development of the idea of action research from the beginning of the 20th century to the present day has been analysed in this chapter. It includes also a survey of the philosophic and theoretical basis of action research. Action research has been viewed as a method of self–perfection for the participants in the research. They educate themselves in the research process acquiring new experience and generate new knowledge developing prototypical thinking.

The significance of creativity, an essential action research component for the new paradigm of knowledge society, has been assessed. Creativity has been analysed from various aspects. They are (1) imagination and originality, which manifest themselves in artistic creativity; (2) creativity rooted in thinking as the construct of the cognitive style. Part of these aspects have been viewed as mutually complementary opposites, as, for example, creativity and adaptation as well as the manifestations of creativity oriented toward sustainability in contrast to manifestations oriented toward the short term and/or destructive unsustainable changes. The importance of creativity in the development of personal professional competences has been also discussed in this chapter. The competences in the professions which in the nearest future will be in high demand in Europe have been viewed in the same context. The significance of creative collaboration in action research has been also assessed in this chapter. The assessment includes various manifestations of collaboration levels in e–learning. Comparative analysis of action research in full–time groups and action research in e–learning revealed the similar and dissimilar traits. The characteristic features of

collaboration in action research in an e–learning environment have been also described. The requirements for a study environment stimulating the cognitive processes and creative activities, attributing them to an essential component of the study environment in e–learning, namely, the e–learning environment, have been also evaluated.

Chapter one centers also on the adequacy of the e–learning technologies to the requirements of a good study environment in educational action research. The concept of e–learning has been defined and a survey of the history of the use of the information and communication technologies (ICT) for educational purposes has been offered. Various methods of using the ICT and their contribution to the study process have been analysed. Collaborative studies in an e–learning environment and an individual's interaction with the ICT have been stressed. The importance of the basic computer skills in e–learning has been assessed. Attention has been paid to the research of various authors on the user–friendliness of the computer interface design and functionality and the main user–friendliness principles have been defined. They can be attributed also to educational action research in an e–learning environment.

Further in this chapter, the teacher's role in an educational action research has been analysed. An educational action research algorithm, based on knowledge construction and acquisition cycles, has been elaborated. In each cycle, the participants analyse three discursive practices — positioning, performance and the construction of meaning. The idea of discursive practices and its compliance with the gist of EAR according to the views of various researchers has been examined. An algorithm for the implementation of EAR in the Business course has been also developed in this chapter. The construction process of personal knowledge in an educational action research oriented toward sustainable development has been analysed.

The general research group has been characterised in the first chapter. The ICT skills have been mentioned as one of the key features of the general research group. A subgroup involved in the research contributes to the characterisation of the general group. A detailed description of the activities of the students and the teachers/e–learning consultants in EAR in an e–learning environment during all the three discursive practices has been also offered in this chapter. The students' activity and the teacher's motivating impact have been described, too. The students and experts have evaluated the EAR methodology and the e–learning environment used in the research and have offered their recommendations for improving them.

In the continuation of the chapter, the description of the e–learning environment used in the research has been offered including the technological requirements relating to the interface functionality and the cognitive processes in EAR. An adequate data flow model and the system architecture model have been developed. This chapter includes also the description of the practical solutions of the interface and its assessment by the students. In keeping with their recommendations and the research described in scientific literature, the solution principles of the student's and the teacher's/e–learning consultant's interfaces have been worked out, which have been used later in the research.

At the end of the chapter, the research method used in elaborating the doctoral thesis has been described and, to demonstrate it graphically, its algorithm in the form of a flowchart has been added. The parameters used to characterise the students' activity and creativity have been also described. The interconnections characterising the students' performance in EAR and their creativity have been identified and the statistical analysis of data has been made, assessing their reliability. The chapter ends with the most important conclusions on the causal relationships in student group work in educational action research.

In Section 1.1, *tasks were performed which had been set studying the action research method as a strategy for creating new knowledge. The following tasks were carried out: (1) literature on the philosophic and pedagogic basis of action research as a learning method and a knowledge generation strategy rooted in research has been assessed from its creation to the present–day use in pedagogic practice; (2) the principles of EAR implementation in the e–learning environment have been evaluated.* In this section, the history of the idea of action research has been described centering on J. Piaget's (Piaget, 1995) cognitive development theory and L.Vygotsky's social constructivism as well as J. Dewey's (Dewey, 1916) education philosophy and holism as the philosophic basis of action research. K. Lewin's action research idea (Lewin, 1946) is also an important step in the development of the theory. Other researchers' contribution to action research deepening our understanding of the method and its most important aspects has been also analysed, including B. Dick's study of the history of the action research theory (Dick 2009).

In this section, action research has been viewed as a hierarchic process from the point of view of the method of analysis and the level of collaboration (Elliott, 1991). The conformity of action research to the prototypical thinking mode has been assessed. The construction of practical living theories has been viewed as an integral component of action research. B. Glaser's (Glaser, 1967) and A. Strauss' ideas about grounded theories as a form of practical theories and their significance in action research, as well as the living theory approach to the educational aspect of action research developed by Kevin Barge (Barge, 2008) and J. Whitehead (Whitehead, 2009) have been also discussed. Examples of the use of action research in constructing knowledge according to C. Owen's model (Owen, 1997) have been added.. The characteristic features of action research in an e–learning environment have been evaluated and the theory of action research for interaction of man and the computer analysed (Kaptelinin, 1999). At the end of the section, attention has been paid to C. Herington's work on encouraging participation in an educational action research (Herington, 2008).

The main conclusions made in the section are that action research as a constructivist theory has developed from the beginning of the 20th century to our days into a knowledge acquisition method based on research and vastly used in educational practice. Action research is an attractive and captivating method of involving the students into the study process. The idea of action research allows various approaches to the design of the method so that it can be suited to specific needs and practices. In action research, the interests and values of the participants play an

important role. No less important is also the creativity in addressing problems topical for the participants of the research.

The action research method can be used both in full–time studies and in acquiring knowledge in an e–learning environment. For this purpose, the design of the study environment should be adjusted to the participants' needs and experience by establishing an environment prototype that suits these needs and experience.

1.2. The growing importance of creativity for sustainability in the labour market

In section 1.2, *the following issues have been addressed: (1) the views of various authors on the concept of creativity have been elucidated; (2) various manifestations of creativity have been assessed; (3) the significance of creativity in acquiring the necessary competences for professions which in the nearest future will be in high demand in Europe has been expounded.*

Various views on the concept of creativity have been disclosed in this section (Runco, 1999). J. Guilford's conception of divergent thinking (Guilford, 1967) has been analysed, as well as M. Kirton's theories of cognitive style which view creativity as one of its constructs (Kirton, 1976). A survey of the main aspects of creativity has been offered (Wallas, 1926; Freud, 1958; Torrance, 1974; Taylor, 1988; Finke, 1992; Runco, 1999; Almeida, 2008; Ferrari, 2009). The significance of creativity for the new paradigm has been viewed in connection with the entry of information and communication technologies into education (Ala-Mutka, 2008) and the holistic transformation of education systems (Selinger, 2008). The requirements for a new learning format and a change of methodology have been identified in the section (Simplicio, 2000). L. Koen's theory of creativity and adaptation and R. Sternberg's and T. Lubart's prototypical view of creativity as signs of a personal process (Sternberg, 1999) have been evaluated. Implicit and explicit theories of creativity have been generalised and graphically illustrated (Ferrari, 2009). M. Runco's theory of the dual nature of creativity involving also negative features (Runco, 2010) and J. Cropley's theory about the development of creativity (Cropley, 1999a), as well as the prototypical features of divergent thinking defined by M. Runco (Runco, 2010) have been analysed. G. Davis' view on barriers hindering creativity has been discussed (Davis, 1999). Ways of assessing creativity — diagnostic assessment (Russ, 2003), formative assessment (Beghetto, 2005) and summarising assessment — have been explained. M. Runco's (Runco, 2003) and A. Craft's (Craft, 2005) views on the role of creativity in educational action research have been analysed. D. Leonard's attitude to the concept of competences and the influence of creativity on their development have been described (Leonard 2005). At the end of the section, the role of creativity in ensuring the competences in professions which in the nearest future will be in high demand in Europe according to the European Qualification Framework (EQF) and the International Standard Classification of Education (ISCED) has been outlined.

The conclusions made in this section are the following: (1) creativity based on personal interests and values is especially important at the time of a paradigm shift — when society experiences transformation into knowledge society; (2) The concept of creativity may be approached from various aspects demonstrating that creativity may manifest itself also in situations which are traditionally not connected with creative activities. Creativity is a personal process and it can be developed in creative activities doing research or by way of reflection which are characteristic features of action research. With society passing over to the paradigm of knowledge society, the role of creativity in developing the necessary competences for professions in high demand will increase. Therefore we have to pay ever greater attention to it in the study process.

1.3 Collaborative learning as an educational action researh

In Section 1.3, *collaboration has been characterised as a factor promoting creativity in educational action research.*

P. Dillenbourg's theory of collaboration levels in e–learning and their creative manifestations have been discussed in this section (Dillenbourg, 1999). Creative collaboration in action research has been interpreted as social interaction (Roschelle, 1995). The similarities and dissimilarities in the collaboration of full–time student groups and those working in an e–learning environment have been analysed and the principles of group collaboration defined by F. Murray have been examined (Murray, 1990). At the end of the section, the characteristic features of collaboration in the e–learning environment in an educational action research have been considered.

The conclusion has been made that creative collaboration in e–laerning can be characterised as social interaction. Similarly, educational action research can be also characterised as social interaction with the aimof constructing and acquiring new knowledge in order to solve urgent problems. Collaboration in full–time study groups and collaboration in an e–learning environment have similar conditions. However, collaboration in an e–learning environment has several advantages — the performance of each collaboration participant can be easily examined and appraised. It allows to look upon collaboration in an e–learning environment as a component stimulating creativity and obliges us in elaborating the e–learning environment prototype to try and fashion an interface design which facilitates collaboration.

1.4 The study environment and the e–learning environment

In Section 1.4, *the role of the study environment in successful educational action research (EAR) has been evaluated and the most important features of an e–learning environment prototype as a component of the study environment have been identified. Special attention has been paid to the compliance of the study environment with the basic philosophic principles of EAR.*

J. Dewey's theory containing the requirements for a study environment stimulating the cognitive processes has been discussed in this section (Dewey, 1997).

It has been stressed that the study environment is a meaningful and stimulating component of man's growth. D. Hansen's views on J. Dewey's criteria for the study environment have been surveyed. The e–learning environment has been analysed as a component of the study environment. The teacher's and the e–learning consultant's role has been considered. A comparative analysis of J. Dewey's requirements concerning the adequacy of the study environment to the needs of successful e–learning and the adequacy of the e–learning envirenment to the needs of a good study environment has been provided. At the end of the section, the requirements for a study environment which satisfies the needs of research in the context of educational action research have been assessed (Salīte, 2009).

The conclusion has been made in this section that a good study environment is a meaningful and stimulating component of man's growth. In an e–learnin environment which is an essential part of the study environment, it is possible to implement the requirements defined as the philosophic basis of educational action research.

1.5. The conformity of e–learning technologies to the requirements of the study environment in action research

1.5.1 The ICT as a creativity stimulating education component

In Section 1.5.1*, the influence of the use of information and communication technologies (ICT) on the learning process in a historical perspective and in connection with various e–learning models in EAR has been evaluated.*

The history of the development of e–learning and A. Loveless' views on the changes in pedagogy with the advent of the modern ICT in the study process have been examined (Loveless, 2007; Loveless, 2008). The concept of e–learning in the interpretation of various authors has been analysed (Conner, 2000; Tavangarian, 2004; Stockley, 2006) . The evolution of learning methods spurred by the ICT and the features of social interaction in e–learning caracteristic of educational action research have been considered (Stahl, 2006). The contribution of information and communication technologies to the development of learning methods has been assessed (Fisher, 2006; Ala-Mutka, 2008), as well as R. Clark's approach to instructional knowledge acquisition methods in e–learning (Clark, 2007) and the adequacy of this approach to the objectives of educational action research. Encouraging creativity in e–learning characteristic of EAR has been also appraised. G. Salmon's model of social constructivism in e–learning for student motivation, socialising and information sharing (Salmon, 2004) and D. Laurilard's conversational framework for using technologies in higher education (Laurillard, 2002) have been appreciated. In relation to the development of e–learning environment prototype, R. Mayer's research on the impact of the interface design of the e–learning environment on the students' motivation and the quality of knowledge acquisition has been looked into (Mayer, 2001). Collaboration in e–learning groups and the optimal size of the groups in EAR have been explored. The success of EAR depends on the cognitive approach to learning in collaborative groups (Wadsworth, 1984). The role

of computer skills for collaboration in study groups as well as the most important factors influencing young people's wish to acquire these skills (Durando, 2008) have been also expounded. The negative influence that the lack of these skills has on the implementation of the Lisbon Strategy has been also mentioned (McCormack, 2008).

We can conclude in this section that the modern ICT have created new opportunities for creativity in the learning process and at the same time new requirements for new technological platforms. The ICT promote the knowledge building potentialities, enhance the cognitive faculties, encourage the establishment of communities and communication in them as well as the ICT user involvement and motivation. Comprehensive use of these opportunities is an essential requirement for designing the prototype of educational action research in an e-learning environment. Collaborative learning in the ICT environment is most effective in small student groups. The ICT skills are an obligatory condition for collaboration in educational action research.

1.5.2 The adequacy of the e–learning environment to the essential traits of educational action research

In Section 1.5.2, *tasks related to the development of an e–learning environment prototype for educational action research were carried out. For tyhis purpose, (1) the basic demands for a good, user–friendly e–learning environment, (2) its adequacy to the essential traits of the cognitive processes, (3) demands for functionality and (4) demands for a user–friendly interface have been analysed.*

In this section, the use of e–learning technologies for the development of creativity as an element of sustainable education has been analysed (Miller, 2005; Kapenieks, 2007). The correspondence of educational action research in an e–learning environment to G. Salmon's five–step model in collaborative e–learning (Salmon, 2002) and B. Bloom's taxonomy for cognitive processes (Bloom, 1956) has been evaluated. For correct analysis, the terms used in pedagogical sciences have been compared with the terms used in ICT research (Kapenieks, 2008). The role of mobile technologies in e–learning which increase the accessibility of educational action research in an e-learning environment has been looked into. The user–friendliness of the e–learning environment and the main requirements for successful performance of EAR have been analysed, namely, A. Lund's (Lund, 1997) and J. Nielsen's (Nielsen, 1993) views on the user–friendliness of the e–learning environment interface and T. Reeves' studies on the importance of taking account of this requirement (Reeves, 2002). The assessment of experts of the requirements for the screen interface design in educational action research, the principles of effective interface design defined by R. Mayer (Mayer, 2001), the personalisation of an e–learning environment in G. Salmon's five–step model (Salmon, 2010) have been also described.

The research conducted in this section leads to the conclusion that the design for the prototype of an e–learning environment in educational action research has to be made according to B. Bloom's taxonomy levels implemented in EAR discursive practice. These requirements correspond to G. Salmon's five–step model for

collaborative e–learning. In designing the interface, the requirements supporting the cognitive processes and corresponding to the philosophic principles of a good learning environment have to be observed.

1.5.3 The methodology of educational action research in open access ICT in the internet

In Section 1.5.3, *tasks have been performed which have helped to develop the e–learning environment for educational action research in open access resources and on the basis of this experience to elaborate an improved e–learning environment prototype. For this purpose, an EAR algorithm based on the philosophy of action research and the theoretical conclusions about its educative effect has been worked out in order to implement it in the e–learning environment.*

The teacher's role as a participant in educative action research, and student–centered pedagogy (Woods, 2002; Burke, 2007) have been described. As the algorithm is based on knowledge acquisition cycles structured by discursive practice, M. Foucault's theory of discursive practice (Foucault, 1972) and its role in educational action research according to R. Young's approach (Young, 2009) have been analysed. The algorithm of educational action research (EAR) as a knowledge construction and acquisition method in an e–learning environment has been defined. It embraces three discursive practices in EAR: (1) positioning, (2) performance and (3) knowledge construction, as seen in Figure 1.

In order to implement the algorithm, the students and the e–learning consultant take several practical steps, therefore further in the section, practical implementation of EAR in an e–learning environment which has been developed by using open source Google Documents software has been described. The students' and the teacher's/e–learning consultant's work style in EAR has been analysed. At the end of the section, the construction of personal knowledge oriented toward sustainable development in acquiring the course in educational action research has been evaluated.

The conclusion has been made in the section that the approach of discursive practice complies with the nature of creative processes and therefore it has to be included into the knowledge acquisition cycles of educational action research. Within the framework of discursive practices, attention has been paid to the global character of the problem. The communication includes both direct and indirect practice, and by way of reflection new knowledge has been constructed. It is possible to implement these processes in an e–learning environment which has been developed by open source Google Documents software.
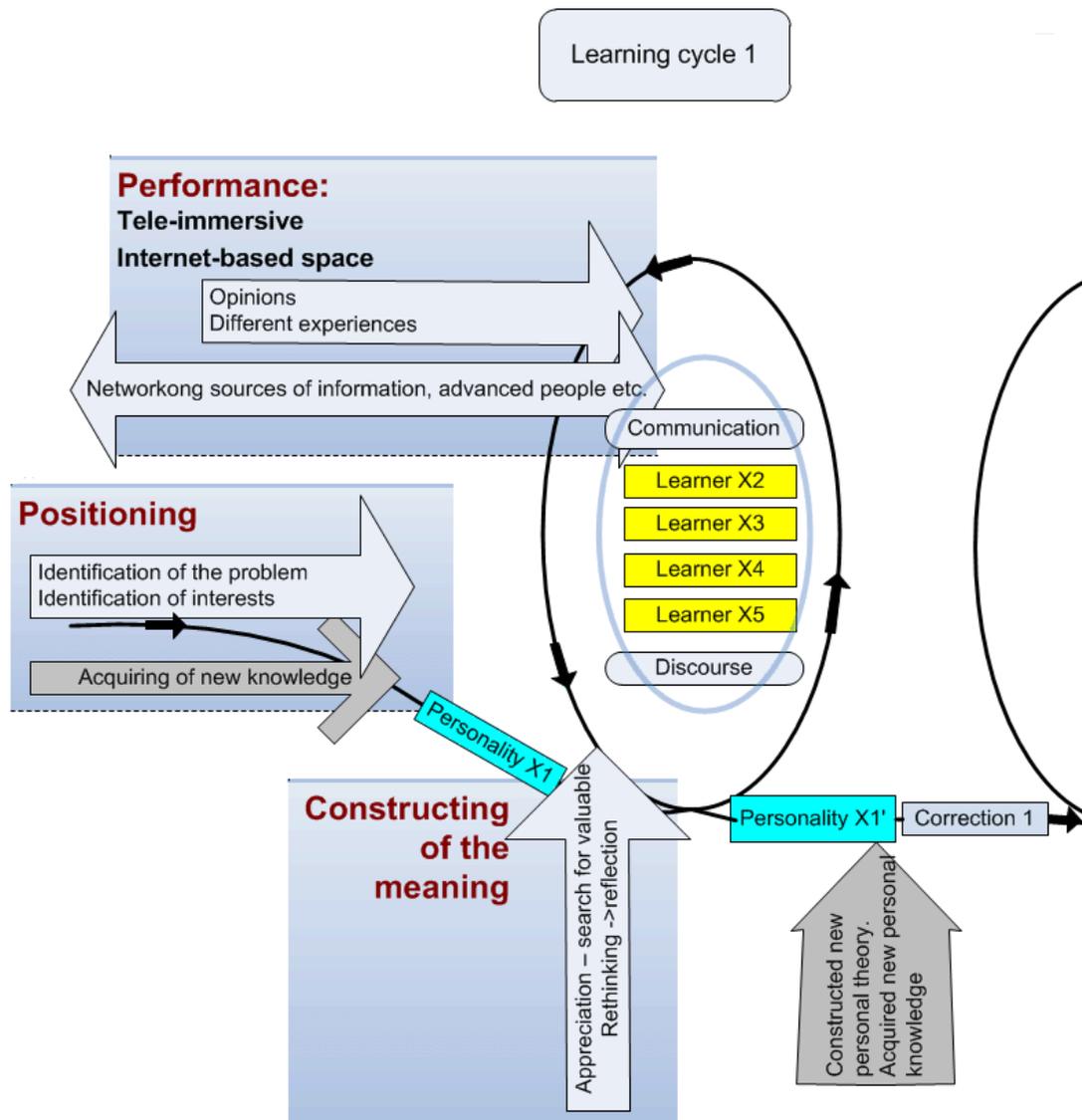
Figure 1. The first knowledge acquisition cycle of EAR in the Business course.

1.5.4 The participants in educational action research

In Section 1.5.4, *information on the participants in educational action research Learning cycle 1has been provided in order to get an answer to the objective of the research — to inquire into the results of knowledge construction and acquisition in an EAR e–learning environment and the impact of the method on the students' interests and values. For this reason, the participants in the research have been characterised and the subgroup involved in EAR has been identifies as a group representing and characterising the general group.*

The members of the general group have been characterisede from the point of view of their ICT skills and attitude to these technologies. The numerical size of the general group has been estimated according to the data provided by the Central Statistical Bureau (CSP 2010; CSP 2011). The dominant intertests and values of the

members of the general group have been characterised in the section. The formal characteristics of the students involved in the resrearch — the selected group — has been provided — their number, gender, their study programme. The students' self–appraisal in relation to their interests and values according to the requirements of successful educational action research has been analysed.

The analysis offered in this section makes us conclude that the skills in using the information and communication technologies and the habit to use them in everyday practice are an essential feature of the general group. The interests of the students of the general group are oriented toward the sciences and natural sciences, yet there is evidence that many students of social and humanitarian programmes also fit the characteristics of the general group. It can be also concluder that the selected group which has been involved in the research can characterise the general group.

1.5.5 The activities of the students involved in the research in an e–learning environment

In Section 1.5.5, *the task to implement educational action research in an e–learning environment into open source internet resources and assess the adequacy of the environment to the needs of the educational action research has been described.*

For this purpose, the EAR activities of the students in the Business course and the way of obtaining data on student activities in an e–learning environment have been described and graphically illustrated. The students' evaluation of the accessibility of computer and internet connection has been conveyed in the section. The student activities in three EAR discursive practices — in positioning, performance and constructing knowledge — have been described and the students' self-appraisal of their activities in EAR has been expounded. The students' activities in EAR and the teacher's/consultant's motivating influence have been characterised and graphically illustrated. Finally, the students' and experts' assessment of the method, its benefits and drawbacks as well as the e–learning environment in Google Documents software used in the research has been imparted. A table summing up the recommendations for preventing shortcomings in the EAR method and the design of the e–learning environment has been added.

It can be concluded that the ICT and the internet connection are available to the students.Their ICT skills are good enough and they are glad to use the ICT. The students successfully performed the procedures within the framework of EAR in the e–learning environment designed by the Google Documents. Nevertheless, they reported several shortcomings of the environment. One of the main shortcomings is an inconvenient screen interface, insufficiently clear arrangement of information and delays due to some of the group mates bein late with their work. The teacher/e–learning consultant has an important motivating role in a successful EAR performance.

1.6. The design of an e–learning environment for collaborative educational action research

1.6. 1 The architecture of the e–learning environment in the available ICT resources

In Section 1.6, *the tasks carried out in the research have been described:(1) to design an e–learning environment for educational action research in open source internet resources and assess its adequacy to the needs of EAR, (2) to find out the shortcomings of the e–learning environment used and eliminate them in designing an updated prototype of an e–learning environment in EAR.*

In section 1.6.1, the choice of open source software for an e–learning environment in educational action research has been substantiated. The substantiation of the principles of choice for the software is based on the condition that the technical potentialities of the software should meet the functional requirements of the e–learning environment. The potentialities of Riga Technical University e–learning environment ORTUS as well as its adequacy for coordinating functions in educational action research and the choice of Google Documents software for EAR in an e–learning environment have been described. The procedures which have to be carried out in an e–learning environment have been analysed in the section. A corresponding data flow model has been elaborated for these procedures in the EAR Google Documents and ORTUS infrastructures. A figure of this model has been added to illustrate it.

1.6.2 The design of an e–learning environment for collaborative educational action research

In Section 1.6.2, *the author's approach to the solution of the interface design in educational action research (EAR) in an e–learning environment according to the principles of multimedia use defined by R. Mayer (Mayer, 2001) has been described.*
The functionality requirements of the design for a successful implementation of EAR have been defined. The functionality requirements for the students' and e–learning consultant's e–learning environment interfaces according to G. Salmon's five–step model for collaborative e–learning (Salmon,2002) and Bloom;s taxonomy of hierarchic thinking levels (Bloom, 1956) in EAR have been analysed and graphically illustrated (they have been analysed more in detail in section 1.5.2). Further different practical solutions of the interface design at different EAR stages have been described. The students' assessment of the adequacy of the interface design to the objectives set has been rendered and the author"s recommendations for its upgrading have been offered.

In Section 1.6, the conclusion has been made that the requirements of functionality design for the e–learning environment interface in the Google Documents environment should promote cognition and collaboration according to

Bloom's taxonomy levels for cognitive processes and G. Salmon's five–step model for collaborative e–learning. It is possible to ensure the functionality requirements by combining the potentialities of the RTU e–learning environment ORTUS and the open source software in the Google Documents environment. However, it is not possible to implement all the interface user-friendliness principles, therefore the e–learning environment has to be improved.
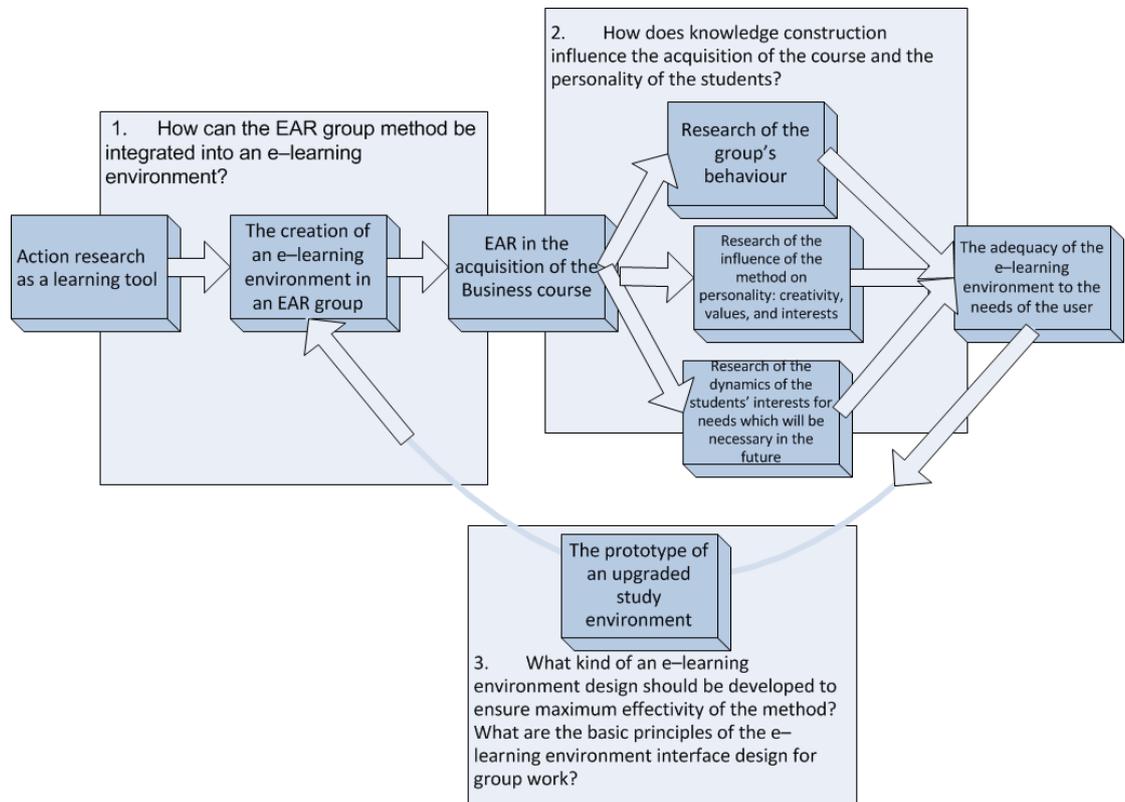

Figure 2. Research algorithm

1.7 The influence of educational action research on the results of acquiring the course and group work

Section 1.7 *contains a detailed description of the course of performing the research tasks: (1) to carry out educational action research in an e–learning environment of open source internet resources; (2) to assess the results of knowledge acquisition and construction;(3) to find out the shortcomings of the e–learning environment in order to design the prototype of an upgraded e–learning environment in EAR.*

At the beginning of the section, the research method used by the author has been described and the algorithm of the research has been developed which has been illustrated in the flowchart seen in Figure 2. The results of the research during the preparatory, performance and data analysis stages have been described. A detailed

characteristic of the group participating in educational action research (EAR) and the method of analysing its work have been conveyed. The parameters for assessing the group members' activity and creativity have been described. By way of statistical analysis, the most important data correlations have been identified and the students' assessment about the benefits of EAR group work conveyed and the detected shortcomings pointed out. At the end of the section, statistical analysis of the data obtained has been provided and in order to assess their credibility, distribution tests with the help of the statistical processing computer programme SPSS have been performed. Student performance in EAR group work has been analysed and the main conclusions provided.

The main conclusions are the following: Group work in an e–learning environment using educational action research has stimulated the students' motivation, interest raising the quality of acquiring the course. In comparison with the full–time groups, several advantages have been identified:

- *The students are not afraid to express innovative ideas creating and acquiring new knowledge in discourse. They learn to accept and assess other students' ideas including them in their own statements.*
- *The groups do not have marked leaders doing most of the work.*
- *A method has been used in the research that allows to assess the students' creativity in action research.*
- *Each student works individually and his/her performance is obvious and can be easily evaluated.*
- *Students whose academic achievement is higher are more creative especially those students whose grade points are 9 out of 10. Students having 10 points are usually slightly less creative.*
- *The students' creativity does not depend on the sequence of their involvement in group work. Students who get involved in group work a little later express more discursive ideas.*
- *The method promotes collaboration in group work.*
- *The shortcomings of group work in an e–learning enviroment are the following:*
- *An opportunity to avoid getting involved in group work thus hindering the work of the group mates .*
- *It is difficult to tell whether a definite student is independent in his/her work.*
- *A comparatively complicated procedure and an inconvenient interface which may impede the EAR process.*
- *The computer skills of the participants largely determine the results of EAR.*

Most students found this study method effective (83 %) and recommended to use it also in other study courses (83 %).

2. The influence of educational action research in an e–learning environment on personality and sustainability in the labour market

2.1 The influence of educational action research in an e–learning environment on the students' interests and values

In Chapter 2, answers to the second research question have been provided: How does the action research method influence the students? Does the development of the students' creativity, interests and values meet the needs of the future knowledge–based professions?

In order to answer these questions, the criteria hindering the assessment of creativity have been identified. In this chapter, the role of interests, views and values in developing the identity of an individual has been analysed. The method of investigating interests has been described. Within its framework, the principles of the attributive grouping of the data obtained have been set out, in order to verify the reliability of the data, their statistical analysis according to the distribution tests has been performed. Graphical interpretation and analysis of the data on changes of the students' interests and values during EAR has been provided. It shows that the students' interests and values during the research progressed toward sustainability — toward development and responsibility. It has been also assessed how these data apply to the general group.

This chapter contains also the description of the professions pointed out by the European Commission as professions which will be necessary in the nearest future in Europe according to the European Union (EQF) and the UN (ISCED) standards. The competences necessary in these professions as well as the interests and values essential for their development have been also identified. It has been found that the dynamics of the students' interests and values is oriented toward the higher EQF and ISCED levels of the professional skills standard, which require creative, innovative and research skills. They correspond to the dynamics of the students interests in EAR and the competences which in the nearest future will be in high demand in European countries.

In Section 2.1, *the influence of EAR in an e–learning environment on the students' interests and values has been investigated.*

The assessment principles of features characterising the personality of the students — their creativity, values and interests — have been set out. Factors making assessment difficult identified by A. Ferrari (Ferrari, 2009) have been also analysed. The method of investigating interests and values within the framework of educational action research has been described in detail. Interests and values have been characterised as textual and contextual construction elements of identity (Porter, 2005). The method of evaluating the students' interests and values has been outlined within the framework of which attributive grouping for data processing has been performed. Statistical analysis of the data obtained — using statistical distribution tests with the help of SPSS and EasyFit data processing software — in order to verify

their reliability has been described. A graphical interpretation of the development of the students' interests and values in EAR during a study semester has been added. The dynamics of the students' interests and values during educational action research has been analysed. It has been also assessed how the correlations obtained according to the criteria defined by S. Kristapsone (Kristapsone, 2011) apply to the general group.

The conclusion made in this section is that the interests, values and views of an individual are important elements characterising his/her identity which have to be taken into account elaborating the methodology of educational action research. They are in a process of dynamic development and educational action research helps to create interests oriented toward research and innovations and values oriented toward development. At the same time, the participants in EAR become socially active and their interests become broader.

2.2 The conformity of the method to the requirements of professional competences which will be in demand in the nearest future

In Section 2.2, the task described in Section 1.2 has been continued: (1) to analyse the research on competences necessary for professions which will be in high demand in Europe in the future and the essential features, interests and values to form them; (2) to assess the adequacy of the interest dynamics of the participants in EAR to the increase of competitiveness and sustainability in the European labour market.

A survey prepared by the European Commission of the professions which will be in high demand in the countries of the European Union in the nearest future has been offered and the competences necessary for them have been characterised (Cedefop, 2008) corresponding to the standards of professional skills of the EU (EQF) and the UN (ISCED) (EC, 2008a). Their compliance with the paradigm of knowledge society in P. Drucker's view (Drucker, 1993; Burch, 2005) has been assessed. The adequacy of personal interests and values to the competences necessary for different professions has been analysed. Finally, according to the data obtained on the dynamics of the interests of the participants in EAR, the adequacy of the development of the students' interests and values to the future professional competences has been analysed.

The conclusion made in this section is that in educational action research, the students' interests and values develop in such a way that their adequacy to the competences necessary for the future professions in high demand in Europe requiring research skills, innovative thinking and the ability to take responsibility increases. Educational action research has a positive influence on the students' competitiveness and sustainability in the labour market.

3. An e–learning environment suitable for educational action research

3.1 An e–learning environment interface suitable for educational action research

Chapter 3 gives an answer to the third research question: How to create an environment design suitable for action research and what kind of e–learning environment prototype should be used for mastering the study courses at higher education institutions? What basic principles of group work should be used in an e–learning environment?

At the beginning of the section, the stages of developing the e–learning environment design have been described: (1) the analysis of direct and indirect experience; (2) the development of the model of an e–learning environment prototype design; (3) the development of the model of the e–learning environment architecture and the model of the data flow; (4) the programming of the prototype. The e–learning environment design suitable for educational action research has been analysed in this section, the architecture of the e–learning environment prototype and the interface design as well as the choice of the software for programming the prototype have been substantiated. Figures have been added to illustrate the developed interface models based on the principles of user–friendliness which have been elaborated in Chapter 1. The figures of the screens illustrate in what way the most important features have been implemented in the interface screens programmed in the prototype.

In Chapter 3, examples of software solutions in programming the functionality of the e–learning environment prototype and the interface design for the Google Apps Client library and the OpenID Client library, for which the Microsoft ASP.NET platform and theVisual Studio 2010 development tool were chosen, have been given.

In this chapter ,the need for unified principles of interface design in order to collaborate in an e–learning environment has been motivated and the views of different authors and experts on this issue have been commented on. Factors determining these principles have been analysed. At the end of this chapter, several new principles of environment interface design for collaboration in e–learning groups based on the results of the research have been defined.

In Section 3.1, the process of developing the interface for the upgraded e–learning environment prototype has been described. The requirements for interface user–friendliness according to the needs of cognition and communication as well as the needs of a good study environment have been analysed in Sections 1.5.2 and 1.6.2, and they have been observed in developing the prototype interface.

In this section, the stages of the development of the e–learning environment interface for educational action research (EAR) have been described and the interface screens have been characterised. The students' interfaces for EAR have been described in detail: the screen for entering the initial information, the interface for group work, the interface screen for creating the living theory, the interface screen for

following the group mates' work, and the student navigation interface. The teacher's/e–learning consultant's interfaces for following and assessing the students' work and the teacher's/e–learning consultant's navigation interface have been also delineated. Figures of interface models based upon the principles explained in Chapter1 illustrate the description. The figures of the screen illustrate the programmed e–learning environment prototype and its characteristic features. At the end of the section, an assessment of the developed interfaces and the main principles on which they are based has been provided.

The main conclusion made in the section is that the chosen programming tools allow to prevent essential shortcomings of the e–learning environment interface for EAR offering to the user all information necessary for the EAR procedure compactly presented on the screen. At the same time, it can be easily complemented. In the developed interface, the user's screen has been personalised, and it is possible to place also video commentaries on it in order to expound and complement one's ideas. The user interface meets all the user–friendliness requirements and makes the students' and the teacher's/e–learning consultant's work in EAR more comfortable.

3.2 The architecture of an e–learning environment for educational action research

In section 3.2, *the process of developing an upgraded e–learning environment prototype and eliminating the initial shortcomings has been explained and the e–learning environment architecture of the upgraded prototype has been presented.*

A model of the upgraded EAR e–learning environment technological solution system has been created and illustrated in a figure. A model of e–learning environment processes has been also created and illustrated in a figure and the basic processes it accomplishes have been described. The data flow model for the students' and the teacher's/e–learning consultant's work in educational action research developed within the framework of the research has been also explained. The performance of these models in the students'authentication process, the group forming process and the process of entering the students' complements has been illustrated.

It has been found that in the process of developing the prototype it is possible to implement the interface models described in Section 3.1 using: (1) for coordination — the RTU e–learning environment ORTUS, (2) for authentication — the Google Account infrastructure, (3) for creating the the interface design— the external server. (4)for data collection and storage — Google Documents infrastructure. This solution provides the possibility to perform all EAR actions from the internet browser in the terminal of the participants in EAR, including from the mobile smartphones without installing a special software in them.

3.3 The e–learning environment solution

In Section 3.3, *the task to develop an upgraded prototype of an e–learning environment eliminating the initial shortcomings has been described.* The software solutions of the upgraded e–learning environment prototype have been commented upon.

The motivation for the choice of software for the e–learning environment prototype in educative action research as well as examples of software solutions for the authentication of the participants in EAR and data entry have been offered in this section.

3.4 The basic principles of efficient group work in an e–learning environment

In Section 3.4, *the task of defining new principles of group work for the e–learning environment interface based on the experience obtained in EAR has been performed.*

In order to define the basic principles of a unified interface design for collaboration in e–learning, the views of J. Nielsen (Nielsen, 1993), A. Lund (Lund, 1997), R. Mayer (Mayer, 2001), G. Salmon (Salmon, 2010) and other experts have been analysed. Factors determining these priciples have been explained. Finally, the interface design principles which have not been mentioned in theoretical literature but have been identified by the author in his research as factors promoting efficient collaboration in an e–learning environment have been provided.

The conclusion made in the section is that EAR makes it possible to define several e–learning environment design principles and principles for group work in an e–learning environment which have not been mentioned in theoretical literature before. It is possible to eliminate shortcomings in the interface design and make it more user–friendly by following the principles identified in the research.

THE SUMMARY AND THE CONCLUSIONS OF THE PRACTICAL PART OF THE RESEARCH

The potentialities of the new information and communication technologies in educative action research in an e–learning environment create opportunities for sustainable development of an individual (1.5.2):

- The information and communication technologies give the possibility to develop the skills to construct personalised knowledge;
- Technological solutions oriented toward the user's needs enable him/her to build personalised experience by way of reflection;
- The mobility of the technologies helps to construct contextual knowledge relevant to the given situation;

- The accessibility and networking of the technologies provide the opportunity to generate knowledge as a discourse collaborating in a discussion;
- Long–term use of the technologies stimulates sustainable development of personality and supports life–long learning.

Educational action research helps to improve the students' study process as they generate knowledge themselves by way of cognition and reflection. The generation of knowledge is the result of prototypical thinking, it is based on direct and indirect experience and is open to new experience. The new information and communication technologies provide the opportunity to perform EAR in the form of e–learning. The elaborated research method allows to quantitatively characterise processes connected with elusive knowledge which are difficult to express in words. Earlier it was characterised intuitively. In the e–learning environment created for this purpose, it is possible to fulfil the basic requirements characteristic of an e–learning environment. EAR in an e–learning environment shows that:

- The students are motivated to participate in EAR within the framework of their study course. They are not shy to voice innovative ideas creating a discourse, constructing and acquiring new knowledge. They learn to accept and access other students' ideas, incorporating them in their own statements;
- The use of this method increases the students'interest in the course they have to acquire and improves the acquisition results;
- EAR develops the students' creativity and it helps to improve the course acquisition results.
- The most creative students in EAR have better results in acquiring the study courses with the exception of those students whose final results are the highest — they are slightly less creative in EAR.

It proves the thesis that in acquiring the courses, the students whose academic achievement is the highest are not those who create the largest amount of new ideas. However, the deficiencies of the knowledge assessment system have to be taken into account: the highest mark is usually given for perfect acquisition of knowledge instead of the skill to apply it creatively.

Educational action research in an e–learning environment makes the traditional e–learning oriented toward problem solving by way of adaptation much more creative. Creativity can be characterised by sustainability in contrast to short–term problem solving by adaptation. This feature of EAR in an e–learning environment can be used to support life–long learning.

Collaboration is an essential component of EAR having a motivating and creativity stimulating meaning. Student group work in an e–learning environment has several nuances that differentiate it from the work of full–time student groups, in which usually one or a few students dominate.

- Student group work in an e–learning environment is easy to supervise and the students' achievements are about the same independent of the sequence of their involvement in group work. It is comparatively easy to assess each student's performance in group work.
- The students are motivated also when they volunteer for EAR because voluntary participation encourages creativity.

- The students' performance and creativity in the EAR group does not depend on the sequence of their involvement in group work. Students who are the last to get involved in group work manage to do only a little less.
- Intensive work when the students do not have to wait long for the reaction of their group mates stimulates the their activity. The supervision and the involvement of the teacher and the e–learning consultant stimulates the students' activity. However, direct involvement and interference into the students' collaboration in EAR is not advisable.

Student group work in EAR provides the possibility to assess the adequacy of the created e–learning environment. The e–learning environment has to provide user–friendly collaboration opportunities in the internet environment to the participants in the EAR group. The study environment of which the e–learning environment is a component has an essential stimulating role in EAR. The EAR algorithm complies with the opportunities offered in an integrated way by the RTU e–learning environment ORTUS and the Google Documents software. The e–learning environment created and used within the framework of the research provides relevant functionality to the EAR, yet it has several shortcomings. The most serious of them is the interface which does not facilitate the cognitive processes in group work. The requirements for the e–learning environment interface in EAR have to be defined according to Bloom's taxonomy levels in cognitive processes and G. Salmon's five–step model for collaborative e–learning. EAR provides the opportunity to identify several principles for the e–learning environment design and group work in an e–learning environment previously not described in theoretical literature.

It is possible to prevent shortomings in the interface design as to its user–friendliness, providing a design according to the principles identified in the research. Within the framework of the research, new architecture of the e–learning environment prototype has been developed which is based on the following functions:
- Coordination — the RTU e–learning environment ORTUS;
- Interface organisation, data entry and presentation — the external web server;
- Authentication — the Google Account;
- Data collection and storage — Google Documents.

Like the environment previously used in the research, it is accessible from any computer and smartphone with the help of an internet browser. It retains the potentialities of the previous environment and its interface is more conducive to the cognitive processes. The interface of the new e–learning prototype makes it easier for the teacher/e–learning consultant to supervise the students' performance and disburdens him/her giving him/her time for analysing and correcting the students' work.

The results of the research prove that the students who participate in EAR create not only new knowledge. Creativity is based on their personal interests and values. In the long term, EAR influences the participants' interests and values perfecting their competences which will be necessary for the professions in high demand in the nearest future. Among them, the most essential are the research skills based on creativity which are necessary for innovation and the ability to take responsibility.

The research proved that EAR in an e–learning environment does not create any difficulties for the students of the general group who have computer skills and access to the internet. Students of other specialities have also many of the characteristic features of the general group (Section 1.5.4). The results of the research show that the method can be used for acquiring different study courses. Its main advantage is the possibility to model comparatively complicated real life situations, to take decisions and to substantiate them without experiencing great stress as well as to receive assessment for one's performance. It does not require additional investments into infrastructure, because it can be used from any terminal having an internet connection. With the development of the modern ICT, the number of such students is growing not only in the science study programmes but also in the social and humanitarian programmes. The academic staff use the ICT in their everyday work more and more, improving their skills. The new EAR e–learning environment interface design will substantially improve the general student group's opportunities to extend the use of the EAR e–learning method. It gives the chance to participate in EAR also to those students whose computer skills are not so good as those of the students involved in the research. However, a more extensive use of the method in the relevant specialities requires additional research and perhaps further upgrading of the e–learning environment and the method itself. The research is adequate for the paradigm of knowledge society, whose key value is knowledge closely connected with practical steps in taking decisions.

Discussion. In the course of the research, the EAR method was used in target groups of different sizes. By a target group the total number of the students of the course involved in EAR is meant (Contrary to the EAR group which for understandable reasons has 4–6 participants). The research showed that the method could be used in large groups (of more than 150 students) of asynchronous e–learning. In these cases, the EAR groups were formed rather quickly. A student who got involved in EAR was included in an EAR group on the same or the following day and could continue working. Especially intensive group formation occurs on the first day after the introductory class. The student activity decreasing, group formation takes a longer time. The conclusion can be made that waiting decreases motivation and the results of EAR grow worse. If the target group is smaller, the impact of waiting is larger and the group formation is slower. In such a case, other principles have to be used for group formation and starting work. The author considers that the best results could be reached if filling in the EAR form would take place during the class. Unfortunately, the technologies are not available for all students if the group has 20–30 students. The author recommends to make it obligatory for the students to start work in 2–3 days. In such a way, all groups could be formed in a short period of time. If the target group is small, it is possible to have classes in the computer room. Thereby, EAR can be conducted as a synchronous class or a video conference, managing a whole EAR cycle during the class. This method turned out to be very efficient, the students worked creatively and seemed to be very interested in it. However, the students' judgements are not very deep since reflection takes more time. The use of this method would depend on the complexity of the material to be

acquired. The benefit of this method is the possibility to continue the discussion in conversation.

It is important to find out whether the educational action research method is adequate for acquiring different study courses. In the research, the EAR method was applied to the Business course. The method was approbated also in a small student group taking the "Professional Communication" course in the form of synchronous e–learning. In both cases, the use of the method was suitable as it was possible to ensure intensive group work. The participants in EAR and the experts have different views on the adequacy of the method for acquiring various courses. Divergent views have been expressed on its adequacy for acquiring complicated course materials — starting with a view that EAR is suitable for acquiring simple issues and ending with a diametrically opposed view. The views on the adequacy of EAR in an e–learning environment for acquiring social and humanitarian courses are also diverse. The multifariousness of views indicates that research of the use of EAR in an e–learning environment for acquiring various courses has to be continued.

The issue of the necessary level of computer skills of the target groups and their importance in EAR is debatable. Today, most young people avail of the potentialities of the computer and the mobile phone. Education is becoming essential also for the older generation who often acquire the computer skills with difficulty. Experience shows that the motivating factor for acquiring the computer skills is the possibility to use them in practice. In such a case, educational action research would motivate the participants to acquire the skills to work in an e–learning environment and would serve as a means for decreasing digital exclusion.

The issue of the participation aspects of the teacher and the e–learning consultant in educational action research in an e–learning environment is also debatable. In each concrete case, the optimal proportion between the motivating role of the teacher and supervision in order to ensure the quality of knowledge acquisition and knowledge construction has to be found. The fact that the presence of an overwhelming authority decreases creativity has to be taken into account. The author holds the view that each case has to be considered separately. The role of the teacher/e–learning consultant in EAR in an e–learning environment has to be further investigated in order to define the general principles.

The research showed that a major gain of the method was the possibility for the teacher to supervise the creative activities of many students. In this, the greatest help is rendered by the participants in EAR themselves as they oversee and complement each other's work and it allows the teacher to assess the participants' performance. The teacher's intellectual resources should not be wasted on organizational issues in an e–learning environment — group formation, sending e–mails, etc. This issue has been addressed within the framework of the research by upgrading the architecture of the e–learning environment and the interface design. With the appearance of new ICT, new opportunities emerge necessitating further research. Not only the computer or the smartphone but also the interactive television may become an integral part of an e–learning environment.

Small external events may also influence the results of EAR. The author has seen that in e–learning small communication problems during the introductory lecture may later substantially impede the study process. In full–time classes, communication errors are easily corrected but in e–learning their consequences are lasting and difficult to prevent. It is like the "butterfly effect" when a small action may lead to a permanent avalanche of consequences. In the course of the research, the introductory lecture was devoted largely to benevolent communication that induces free discussions and stimulates creativity. The participants in EAR were positively tuned to the EAR method in an e–learning environment.

The directions for further research in an e–learning environment in order to develop the participants' creativity would be the following:

- The use of the method in in target groups of various size, interests and skills.
- The use of EAR for the acquisition of various courses and themes.
- The integration of the method into the acquisition of computer skills.
- The participation of the teacher/e–learning consultant in EAR.
- The use of the new ICT for upgrading the e–learning environment.

Within the framework of the research, the author cooperated with the colleagues from Riga Technical University, Daugavpils University, Liepāja University and Vidzeme University College. Their interest and experience in research, pedagogy and e–learning had great importance in the research. The author expresses his gratitude to his colleagues for their opinion and help and the successful cooperation among higher education institutions in Latvia. Cooperation is an important condition in integrating the research in pedagogy and the use of e–learning technologies into a transboundary and interdisciplinary research.