

Agricultural Engineering and Pedagogical Sciences at the Faculty of Engineering

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Abstract. At the Faculty of Engineering, research is carried out in two directions – engineering sciences, and pedagogical sciences. In the sphere of engineering sciences, the main directions of research are: development of mechanization means for conditioning of energetic plant biomass that is needed for production of solid fuel; supply of optimal microclimate on pig farms; efficient utilization of solar radiation in grain drying and production of hot water; production of alternative fuels; influence of biofuels on dynamic parameters; consumption of fuel and composition of exhaust gases of internal combustion engines; usage of climatic factors in the process of grain conditioning and storage; development of animal production machinery and technologies; research in energy efficiency of water supply and waste water engineering systems, and development of waste water aeration equipment management systems; development of biogas production technologies; research in technological, ecological and energetic aspects of micro-cogeneration in autonomous energy supply using biogas. In the sphere of pedagogics, the main research trends are: ecology of education, competence in rural environment, professional and career education, life quality in the context of home environment, and natural and engineering didactics.

Key words: engineering science, pedagogical science, biomass, biofuel, education.

Introduction

The Faculty of Engineering was founded in 1944. Till 1996 it was called the Faculty of Agricultural Mechanisation. During the whole time of its existence, the teachers together with pedagogical work have actively carried out research. It was promoted by establishment of post-graduate courses at the Academy in 1945 and the right to award scientific degrees in 1946. During the Soviet times, 86 teachers were awarded the Doctor degree (Candidate of sciences), and 7 – Doctor hab. degree. During that period at the Scientific Council of the Latvian Agricultural Academy and specialized councils at the Faculty, in the field of agricultural mechanization and electrification, 160 Doctoral and 7 Doctoral hab. theses have been defended. Since 1991, 5 teachers of the Faculty have obtained Dr.sc.ing., 8 teachers – Dr.paed. scientific degree, and 5 teachers – Dr. habil. sc.ing. degree. The present article summarizes information on the scope of scientific activities at the Faculty since 1991 up to the present.

Grain Pretreatment and Storage

Pretreatment and storage of grain is a traditional and long-term field of research at the Faculty (E. Bērziņš (1934-2004), J. Palabinskis, A. Ābolītiņš, P. Rivža, I. Arhipova, S. Arhipovs, A. Lauva). Energetic research in grain drying technologies is continued. The research has resulted in the doctoral hab. thesis of the long-term supervisor of the research direction professor E. Bērziņš (Bērziņš, 1996). The 1990s of the last century in Latvia were characterized by reconstruction of grain dryers and construction of new buildings. During the research, new grain drying and storage technological and technical solutions were developed. Several grain drying and aeration technologies and equipment constructions have obtained patents (Soviet Union (SU) patent 1706455, Russian Federation (RF) patent 2016504, Latvian (LV) patent 10740). The optimal regimes for grain drying with active aeration and grain feeding in layers (Раецкис, 1990) and grain after-drying with aeration (Палабинскис, 1998) were substantiated in order to apply the heat accumulated in grain in the dryer for carrying out of moisture for drying in the subsequent process of aeration. A theoretical model for evaluation of the efficiency of usage of heat accumulated in grain in the process of after-drying has been developed. One of the main trends of practical research in the 1990s was preparation of recommendations for practitioners for improvement of grain drying and storage efficiency using mathematical modelling of grain drying and storage processes in different stages and conditions of drying and storage. The aspects of methodology and mathematical

modelling of grain drying and storage processes have resulted in two Doctoral theses (Arhipova, 1994; Āboltiņš, 1993) and one Doctoral hab. thesis (Rivža, 1995). Since 1990, the results of this research have been presented in 16 presentations in international scientific conferences and 37 publications, including issues of international character (Berzins, 1993; Aboltins, 1997; Aboltins, Berzins, 2004).

With the changes in the equipment of grain drying, the researchers of the group in co-operation with the Agricultural Machinery Certification and Testing Centre followed the procedure of this process and participated in evaluation of the grain drying equipment. Since 1996, co-operation with the company "Baltic Instruments" Ltd has been continued, in the result of which an up-dated grain active ventilation process control equipment GK-01 with a three-phase non-contact commutator BK-01 using the patented algorithm has been developed (LR patent 12096).

At the end of the 1990s, active energy research in grain drying air heating solar collectors started. A two-flow stationary solar collector has been developed for simultaneous comparative research in two different absorbents, and sun-following equipment has been built that serves as the carrying base for experimental solar collectors to investigate their construction and efficiency of absorbents with the following scope 360° and the following step 0.5°. The results of the research show that the obtained amount of heat from the sun-following collector with metal absorbent is up to 43% larger than that of a stationary collector. A pilot project of a mobile pull-up solar collector has been developed. The research is being continued.

In the middle of the present decade, research in ozone application technologies has been started in grain drying at low air temperature. In laboratory experiments it has been stated that carrying out of moisture from grain is more efficient if grain is actively aerated with ozonized air. Laboratory experiments prove efficiency of the presence of ozone in the process of grain active aeration.

Machinery and Technology of Animal Production

In the first half of the 1990s, professor A. L. Skramans (Profesors ..., 2005) (1915-1996) actively continued to work in the field of animal housing machinery and developed a two-stage pulsator for milking machines which, according to the evaluation of Danish experts, corresponded to the EU requirements. The professor organized also production of it and at that time it was very popular and demanded.

Under the leadership of professor J. Priekulis, research in rational milk production technologies and machinery including environment protection aspects has been carried out. He has elaborated methods and economically evaluated different milk production technologies. The results of the research are summarized in two monographs (Priekulis, 2000; 2008). Research in milk production technologies has resulted in a promotion work (Zujs, 2005). A Latvian patent (13276) has been received for the technical solution for economy of heat energy during automatic washing of the milking equipment. According to the request of the Ministry of Agriculture and Environment, different normative materials on technological design of animal farms taking into account environmental aspects were developed, including preparation of two standards. The research results are reflected in 66 presentations at international scientific conferences, 20 publications in international scientific issues, and 101 other publications.

The leading researcher A. Laurs carries out research in the new dairy technologies including precise dairy production and management systems. He has participated in remaking of the international standard on milking equipment. The research of A. Laurs and J. Priekulis is summarized in a monograph (Laurs, Priekulis, 2001).

Recently a new field of research has arisen – application of milking robots. The research results are reflected in 33 presentations at international scientific conferences, 36 publications in international scientific issues, 26 publications in scientific issues in Latvia, including four monographs, and 55 other publications.

Sapropel Extraction Technologies and Energetic Plant Biomass Conditioning

At the beginning of the 1990s, the Scientific laboratory of Mechanics of Agricultural Machines continued experimental and theoretical research in physical-mechanical properties of Latvian lake sapropel (Ē. Kronbergs, A. Kaķītis, A. Mežs, I. Plūme, and A. Vidužs). The research allowed designing a sapropel extraction equipment in the lake Lobe (Ē. Kronbergs, A. Vidužs, A. Mežs, SU patent 1609883) and supervising its production.

After the Land reform, when large collective and state farms were converted into smaller ones, obtaining of sapropel becomes too expensive for them. According to their needs, small-scope technologies for extraction and application of sapropel and lake biomass were developed, patented and researched (LV patents 11752, 11753, 12127, and 12155). These investigations have resulted in a dissertation (Kaķītis, 1999). The research results are presented in 9 presentations at international scientific conferences, 5 publications in international scientific issues, 4 publications in scientific issues in Latvia, and 18 other publications.

Due to the increased energy costs and different legislation limitations on environment technologies, extraction of sapropel currently in Latvia is almost stopped. In the 1990s, co-operation with Rupert Bevan, a researcher from Great Britain, was started. After defending his Master paper (on application of sapropel), R. Bevan was the initiator of the establishment of the company "Zander Corporation". Its operation is active in development of different environment technologies in Asian and African countries.

At present, with energetic and ecological problems dominating today, the Scientific laboratory is working at development of mechanization tools for conditioning of energetic plant biomass that is needed for production of fuel. During the research, several patented facilities have been developed (LV patents 12409, 12435, 12465, 13447, and 13597).

The statements obtained in the research are reflected in the proceedings of international conferences "The 1st and 2nd World Conference on Application of Biomass" (Kronbergs et al., 2000; 2004) and in the proceedings of European conferences on application of biomass in Amsterdam and Berlin (Kronbergs et al., 2002; Smits et al., 2007), as well as in the proceedings of other international scientific conferences. The research results are presented in 44 presentations at international scientific conferences, 44 scientific publications in international issues, and 8 other publications. The research has resulted also in a promotion work (Nulle, 2008). At present the dissertation of M. Smits "Mechanisation of culm material conditioning processes" is almost finished, and it is devoted to the development of design methods of biomass cutting and compacting mechanization tools. The doctoral student J. Lāceklijs-Betmanis is carrying out research in pressure oscillations in tractor hydraulics systems. Master students G. Liepiņš, D. Ancāns and A. Hausmanis are developing mechanization tools for application of them in obtaining of alternative energy, but E. Repše is investigating application possibilities of the program "Working model" in modelling of operation of agricultural machines.

Chain Equipment and Disc Brakes

Under the leadership of professor G. Uzklīņģis research started earlier in rolling chain links and conveyor chain equipment is continued. In the result of the research, a new theory for designing of the chain equipment, increasing of the quality and resources using dismountable plate chains with rolling friction links and multi-step sprockets has been developed, two-shaft and multi-shaft rolling chain contour universal mathematical model has been elaborated, as well as an optimal link synthesis and rolling chain selection method has been developed, and geometrical-kinematic criteria for evaluation of the quality of the chain contour have been elaborated. For his research work, professor G. Uzklīņģis was awarded the degree of Dr.habil.sc.ing. (Uzklīņģis, 1994). The link rolling process, its insurance and mesh of such chain with sprockets have been investigated. The chain constructions are patented (LV patents 10417, 13694, and 13695). Experimental research proves working ability of such chains. Lately research is carried out in increase of the operational abilities of single disc brakes (G. Uzklīņģis, J. Feldmanis). Theoretically and experimentally brake shoe wear and heating in co-operation with the Jelgava Machine Building plant are investigated. In the result of the research, the construction of such brakes has already been improved. The main results: uniform wear of brake shoes along the whole active surface and complex design methodology of such brake friction couple, considering wear as well as heating. The research results are presented in 9 presentations at international scientific conferences, 6 scientific publications in international issues, 10 scientific publications in Latvia, and 20 other publications.

Optimal Microclimate and Usage of Solar Energy

Under the leadership of professor I. Ziemelis, research is carried out in technical ensuring of optimal microclimate on pig farms and on usage of renewable energetic resources. Constructive, heat, technical, economic and other parameters of electrically and hot water heated concrete floors and panels for pig farms have been determined (SU

patent 1687152, LR patent 12465). They are tested in laboratory and farm conditions. The main combined pig heating (infrared radiation and heated floors) parameters have been determined (SU patent 1595412, LR patents 12996). Several pig lie heating pressure control constructions have been designed, produced and introduced. Engineering and technical aspects of pig radiation with ultraviolet rays are researched in. The research results are reflected in proceedings of 18 international conferences, 29 scientific issues, and 9 other publications. Pig farm ventilation systems using heat exchangers and heat pumps are developed and tested in laboratory and farm conditions (LR patents 13559, 13712, and 13726). The research results are reflected in proceedings of 28 international conferences, 7 scientific issues, and 16 other publications. Lecturer L. Kanceviča has prepared doctoral thesis "Solar energy collector with reflectors", and doctoral student Ž. Jesko is working at promotion work "Substantiation of several original constructions of solar energy collectors".

Resistance of Wood and Flaky Constructions

Under the leadership of associate professor V. Pušinskis (1936-2008) and in co-operation with the Department of Wood Processing of the Forest Faculty, research in birch wood and birch veneer application properties and the quality of pallet material have been continued. V. Pušinskis was awarded the degree of Dr.sc.ing. (Пушинский, 1996). The results are presented in 9 presentations at international scientific conferences, 10 scientific publications in international issues, 6 scientific publications in Latvia, and 14 other publications.

Professor G. Vērdiņš researches in the field of resistance of flaky construction material shapes. In the result of the research, three Latvian patents for different constructive solutions have been obtained (No. 12079, 12104, and 12191). The research results are presented in 4 presentations at international scientific conferences, 4 international scientific issues, 5 scientific issues in Latvia, and 2 other publications. Further research trends are: improvement of construction material corrosion resistance and application of nanomaterials in lubricants.

Servicing and Rational Application of Machinery

In the 1990s, research in the field of servicing and rational application of agricultural machinery was continued (J. Tupiņš, M. Ķīsis, J. Lācars (1935–2003), G. Aizsils). For this research Z. Grants obtained the degree of Dr.sc.ing. (Grants, 1995). The research results are reflected in 10 presentations at international scientific conferences, 8 articles in international scientific issues, 6 scientific issues in Latvia, and 38 other publications, including 4 monographs. At present the researchers of the Institute of Power Vehicles (G. Birzietis, D. Berjoza) are continuing research in the field of power vehicle dynamic parameter registration and analysis. In the result of the research, a patented equipment parameter registration system has been developed (LV patent 13704). The research results are presented at 4 international scientific conferences, and 4 international scientific issues.

Under the leadership of professor J. G. Pommers (worked at the Faculty till 2000), a research was carried out in the field of automobile application properties (power vehicle body coefficient for determination of air resistance, changes in fuel consumption, etc.). For research in this field, J. G. Pommers was awarded the degree of Dr.habil.sc.ing. (Pommers, 1993). This research has resulted in the promotion work of D. Berjoza (Berjoza, 1999). The research results are presented in 4 presentations at international scientific conferences, 2 scientific publications in international issues, 2 scientific publications in Latvia, and 28 other publications. Professor Pommers has researched also into the aspects of development of higher education and technical terminology. These issues are reflected in 8 presentations at international scientific conferences, 4 scientific publications in international issues, 3 scientific publications in Latvia, and 18 other publications.

Obtaining and Application of Biofuels

At the end of the 1980s, under the leadership of professor V. Gulbis (1929-2008) research in the field of alternative fuels was started and is still going on: usage of wood gas, ethanol-gasoline mixture, biodiesel fuel – rape seed oil ethylester and methylester fuels and their mixtures with fossil diesel fuel as well as pure rape seed oil as fuel in diesel engines. For research in the field of alcohol fuel application, G. Birzietis was awarded the

degree of Dr.sc.ing. (Birzietis, 1997). R. Šmigins has prepared promotion work on the influence of biofuels on the parameters of diesel engines, and I. Dukulis – on modelling and optimization of rape oil as a biofuel logistics system. Doctoral student V. Pīrs is researching into application of bioethanol in internal combustion engines. Technology for wood waste gasification and purification, and cooling of wood gas in order to obtain qualitative wood gas for application in gas diesels and gas engines at small capacity (up to 1 MW) cogeneration motor stations has been developed. Research in ethanol–gasoline mixture mutual solution has been carried out. Characteristic curves of octane number variations in different types of gasoline have been obtained. Characteristic curves of engine effective power, torque, fuel consumption as well as exhaust gas component CO, HC changes depending on the engine revolutions and load with the engine operating with pure gasoline as well as with 5 to 20% ethanol mixture fuels have been obtained based on the research carried out on the engine testing stand. Several types of diesel engines have been changed for work with pure rape oil, and research into the changes of dynamic, economic and ecologic parameters on the engine stand as well as on the roller stand has been started. The engine Ford Sierra 2.3L has been equipped with oil pre-heating system, and on the engine stand characteristic curves of power, torque and fuel consumption have been obtained with the engine operating with pure rape oil. Research into usage of rape oil fed cars has been started. The first test results have been summarized in real driving cycles as well as using the roller stand MD-1750 and the precise fuel consumption measuring device AVL KMA Mobile. To increase credibility of the results, synthetic experiment methods have been elaborated, which allows to maximally approximate the automobile laboratory measurements to actual operation conditions. Deep research in combustion processes for diesel engines operating with diesel fuel and biodiesel fuel mixtures has been carried out. In the result of deepened research in combustion processes working with biodiesel fuel and its mixtures at definite revolutions of the crankshaft and stable injection outpace angle reduction of indicated pressure was stated. The experiments also proved that the pace of pressure reduces if RME concentration in the mixture increases, which is related to reduction in fuel heating capacity. The research results are reflected in 40 presentations at international scientific conferences, 29 articles in international scientific issues, 14 scientific issues in Latvia, and 33 other publications, including 4 monographs.

In future, research in the technical solutions of biogas application in power vehicles as well as in the ecological and economically effective solutions in perspective automobiles and tractors of the 2nd generation is planned.

Under supervision of the leading researcher G. Brēmers, laboratory type equipment for obtaining of absolute alcohol with the method of salt distillation method has been developed, and a new raw alcohol distillation method has been elaborated that is called “continuous operation non-phlegm salt distillation” and experimental equipment for improvement of the method has been developed. Application of these methods in production could reduce the energy consumption for dehydration of bioethanol by up to 50%, which would in turn allow reducing the bioethanol production costs. Basing on experimental research experience of the above-mentioned methods, the newest congruent bioethanol dehydration method has been elaborated which implementation could reduce the energy consumption even more (by 70%). In order to make the method closer to practice, at present in laboratory equipment research in congruent dehydration technology units and construction principles of the equipment is carried out. The developed constructive solutions are protected by five Latvian patents (No. 13350, 13351, 13507, 13691, and 13810). The research results are reflected in 15 presentations at international scientific conferences, 11 articles in international scientific issues, including the proceedings of the 14th European Biomass conference (Bremers et al., 2005), and in 6 scientific articles in Latvia as well as in 2 other publications.

Protection of Electro Engines and Kinds of Alternative Energy

At the Institute of Agricultural Energetics, the research started by professor A. Grundulis (1934-2004) was continued in automated protection of electro engines (A. Šnīders, P. Leščevics, and A. Galiņš). After 1990, basing on this research, one doctor hab. dissertation (Šnīders, 1993) and one doctor dissertation (Galiņš, 1996) were defended. The research results are presented in 5 presentations at international scientific conferences, 8 international scientific issues, 13 scientific issues in Latvia, and 10 other publications, including 6 monographs. At the beginning of the 1990s, under

the leadership of professor A. Grundulis, research was started in the field of the kinds of alternative energy (A. Galiņš, K. Zihmane-Rītiņa) – wind, solar, biofuel energy sources and combined energy supply. In the result of this research, one doctor dissertation has been defended (Zihmane-Rītiņa, 2008). With the initiative of professor A. Grundulis, on farm "Toleni", Vircava village, a solar collector was installed with the absorber area of 120 m² (1992), and it was used for scientific research, grain drying and practical technological demonstrations. On this farm also a wind investigation site was built where wind data were collected. At present, two wind generators produced at the Institute of Agricultural Energetics are installed there. The research results are presented in 17 presentations at international scientific conferences, 15 international scientific issues, 4 scientific issues in Latvia, and 19 other publications. Simultaneously research in alternative ways of heating was carried out (A. Galiņš, E. Visockis), and in the result a doctor dissertation was defended (Visockis, 2008).

Under the leadership of Dr.sc.ing. V. Dubrovskis, a laboratory was established for research in biogas production processes. In the laboratory, 3 bioreactor blocks with 4 bioreactors in each were installed where the biogas production process and potential from different kinds of biomass are investigated (I. Plūme, I. Straume). At present, on the basis of the laboratory research, three promotion papers, one bachelor paper and one master paper are elaborated. Also self-made laboratory equipment for research in dry fermentation processes has been installed. The results of the original research carried out in the laboratory (in 2008 – 22 investigations) are presented in 13 presentations at international scientific conferences, 12 articles in international scientific issues, 6 scientific issues in Latvia, and 9 other publications.

Control of Technological Processes

Under the leadership of professor A. Šnīders, research (A. Laizāns, R. Šeļegovskis, I. Straume, and A. Jēkabsons) is carried out in micro-cogeneration technological, ecological and energetic aspects in autonomous energy supply using biogas that is obtained from wastewater sludge and agricultural biomass in the process of anaerobic processing in methane tanks; in energy activity of water supply and wastewater engineering systems, and improvement of the management quality of wastewater aeration equipment and frequency regulated electric drive using invariant management principles with improved parameters. Mathematic and simulation modelling in MATLAB-SIMULINK environment with variable parameters in the process has been done for wastewater aeration tanks as non-stationary wastewater oxidation objects developing a virtual model of the aeration tank with adaptation ability. Methods for aeration, micro-cogeneration and heat supply engineering system transition process for simulation modelling in SIMULINK environment and optimization of operation have been developed elaborating physical system parameter virtual adaptation models for determined and stochastic perturbations with virtual adaptation of changing in time parameters during the whole length of simulation of the process of technological equipment operation. The constructive solutions developed in the result of the research are protected by 4 Latvian patents (No. 13364, 13476, 13620, and 13787). The research has resulted in a promotion work (Šeļegovskis, 2005). A. Laizāns has finished a promotion work on improvement of the management and energy efficiency of wastewater aeration engineering systems. Doctoral student I. Straume continues to work at promotion work on application possibilities of regulated micro heat and electricity cogeneration stations as autonomous heat and electro energy sources on farms. The research results are summarized in 17 presentations at international scientific conferences, 17 articles in international scientific issues, 6 scientific issues in Latvia, and several other publications.

Professor G. Moskvins researches in intellectual systems and technologies in the field of agriculture. Based on the theoretical principles of the intellectual system and artificial intellect methods, mathematical insurance and devices for testing and evaluation of the compliance of agricultural products, food and other products have been developed. For summary of the research results, the author was awarded the doctor hab. degree (Moskvins, 1996). For the technical and technological solutions obtained in the result of the research, 67 patents have been obtained, including 12 abroad. The research results are reflected in 17 reports at international scientific conferences, 17 articles in international scientific issues, 6 scientific issues in Latvia, and 18 other publications, including 7 monographs.

History of Education, Science and Machinery

At the Faculty, also research in the field of the history of education, science and machinery is carried out (K. Vārtukapteinis, J. Ozols, A. Čukure, J. Tupiņš). The research results are presented in 21 presentations at international scientific conferences, 6 articles in international scientific issues, 17 scientific issues in Latvia, and 87 other publications, including 14 monographs.

Pedagogical Environment Research

Research in the field of pedagogics at the Faculty started already in the 1960s. The first dissertation in pedagogical sciences was defended already in 1967 by J. Blīvis, a teacher of the Department of Tractors and Automobiles (Бливис, 1967).

The research in pedagogical science is concentrated at the Institute of Education and Home Economics and is carried out mainly in countryside environment or in organizations related to rural areas. The selection of the themes, aims and tasks of the research is determined by the necessity to solve education problems in regions. The research is carried out in the sub-branches of comprehensive schools, higher schools, and adult and branch pedagogics in five research trends: ecology of education, competence in rural environment, professional and career education, life quality in the context of home environment, and natural and engineering didactics. Pedagogical environment research was started in the 1990s and is still continued (A. Aizsila, I. Apsīte, R. Baltušīte, B. Briede, I. Katane, L. Pēks, T. Sēja (1955-2009), etc.). Long-term pedagogical experience of researchers and achievements of the graduates from the Faculty of Agricultural Mechanization at work have been evaluated. It has been stated that it is strongly influenced by the social environment of studies and the formal education obtained in it. The statements were theoretically substantiated and experimentally tested that essential characteristics of pedagogical environment are multifamily, activities friendly to the participants of studies and possibilities to manage their emotional conditions. Under the influence of human ecological theories and conceptions, education ecology research was continued and it transformed and extended through formation and development of the branch of educational ecology. In the result of the research, the philosophical-methodological basis of education ecology was developed and the role of education ecology among the many sub-trends of human ecology was substantiated. Recently work at development of the conceptual substantiation of ecology education is continuing. The research characterizes the multifirmity of the educational paradigm today, which shows the changing processes in society, development of science and pluralism in the democratic educational environment. Scientific substantiation of the ecological paradigm in education and complementarity of conceptual approaches has been given. The system approach in development of environmental models has been substantiated respecting the structural, functional and evolutionary aspects of environment, and the basic principles of ecological approach in education have been formulated and substantiated. The research has resulted in a promotion work (Katane, 2005). The research results are reflected in 54 presentations at scientific international conferences, 62 articles in international scientific issues, 5 scientific issues in Latvia, and 38 other publications, including 4 monographs. In the future dissertation of R. Baltušīte "Development of future teacher readiness for professional activities in school education environment" research is carried out in scientific substantiation of the notion "readiness for professional activities" and techniques of diagnostics as well as in development of the model of future teacher pedagogical internship at school. In the doctoral dissertation of I. Kalniņa "Development of secondary school student competitiveness in the process of non-formal career commercial education at country school", research is carried out in the scientific substantiation of the notions "personal competitiveness" and "competitive specialist", development of techniques of diagnostics and indicator systems as well as in elaboration of non-formal commercial education didactic model in the context of career education at school. In the doctoral dissertation of D. Penke "Professional self-determination of countryside students in the process of elementary school career education", a career education model at country school has been developed, and work is carried on at periodisation of human professional formation and development, scientific substantiation of personal professional self-determination and its diagnostics. The scientific and practical contribution of the research in education quality of future teachers is substantiated in the future dissertation of I. Apsīte "Development of reflection in teacher education at higher school".

Competence as a Topical Pedagogical Category

At the end of the 1990s theoretical and practical research in competence as a topical pedagogical category was started (B. Briede, A. Zeidmane, and M. Laitāne). The aspects, kinds and components of research in competences, relation of competence with micro-, mezzo-, exo-, and macro-systems as a necessary precondition for today's specialists in any branch have been evaluated. Research is continued in development, evaluation of competence, and professional characteristics. A further education model of agricultural advisors has been developed and introduced in the Latvian Rural Advisory and Training Centre and acknowledged at the Ministry of Agriculture. The advisor competence levels included in the model are the base for systematic organization and formation of the content of further education. The research has resulted in two promotion papers (Briede, 1996; Laitāne, 2003). Definite results in the research in competences have been achieved also in several future promotion papers: A. Sala "Development of student research competences in course papers", V. Tomšons "Development of life-long education competences in undergraduate studies", O. Turuševa "Learning competence development models for first year students". The research results are reflected in 56 presentations at international scientific conferences, 63 articles in international scientific publications, 8 scientific articles in Latvia, and 20 other publications, including two monographs.

Professional and Career Education

Professional and career education research (A. Aizsila, B. Briede, A. Ķirse, L. Pēks, T. Sēja, and I. Soika) in the sphere of formal as well as informal education is carried out in co-operation with other structural units of the LLU, Latvian higher schools, Latvian professional secondary education schools and colleges as well as with foreign educational institutions. In the 1990s, proposals for development of a model for training of farmers, its content and implementation in agricultural technical schools and schools were elaborated. Based on the research results, a further education program for training teachers and a series of didactic teaching aids were developed. They are approbated in work with more than 500 working or future teachers. The changes in the Latvian professional education system are analyzed from the approach of regional development, and methodical proposals are developed for preparation and assessment of scenarios for development of the system of education. Four scenarios of the development of professional education are elaborated: traditional, economic, sustainable development, and co-operation. Their assessment criteria are defined: quality of education, interests of students, possibilities to use the EU funds, decrease of social stress, co-operation with enterprises, etc. The research has resulted in two promotion papers (Aizsila, 1997; Sēja, 2008). It is continued also in future promotion papers, for instance, I. Soika "Dialogue for motivation of rural vocational secondary school students for studies at higher schools", I. Augskalne "Research in the world outlook of professional school students", L. Alondere "Readiness of youngsters for studies at college". The research results are reflected in 74 presentations at international scientific conferences, 84 articles in international scientific publications, 8 scientific articles in Latvia, and 53 other publications, including two monographs.

Life Quality in the Context of Home Environment

Life quality in the context of home environment includes research in improvement of the quality of persons and society as one of the strategic aim guidelines of continuous life-long education and one of the aims of the model for the development of Latvia (Z. Beitere, V. Dišlere, I. Līce, A. Pridāne, S. Reihmane, I. Spulle, and V. Vanovska). The research evaluates life quality conceptions, theories and their development trends as well as life quality multi-dimensional aspects: social, economic, political, welfare, safety, sustainability etc. The research stresses life quality indices, its objective and subjective criteria; UNO human potential development index and its components: lifetime, health condition, welfare level, etc.; quality of life in the context of ecosophy and ecology; correlations of primary (raw materials, natural environment) and secondary (things created by people) environment and its influence on personal development. Several investigations are devoted to evaluation of consumption, its alternatives and influence from the point of view of philosophy, ecosophy, psychology and economics as well as to the positive and negative aspects of consumer education. In this respect there are many investigations in home economics education development problems: content to be acquired, aim, co-ordination of tasks and results, formation of creativeness and

self-realization need; socialization and culturalisation processes in the context of life quality economic, spiritual and cultural criteria. The research has resulted in two promotion papers (Dišlere, 1997; Līce, 2005). Scientific and practical contribution can be already seen in several future promotion papers: A. Pridāne "Implementation of the principle of life quality in home economics education at primary school", and N. Vronska "IT in home economics studies at higher schools". The research results are reflected in 36 presentations at international scientific conferences, 39 articles in international scientific publications, 6 scientific articles in Latvia, and 9 other publications, including one monograph.

In the field of natural and engineering sciences, one promotion work has been defended (Zeidmane, 1996) and there is some contribution also in several future promotion papers: I. Bīmane "Didactic model of land surveying and geodesy courses", S. Čerņajeva "Development trends of the study program of mathematics in engineering in Latvia", O. Vronskis "Substantiation of methodical techniques in virtual studies of engineering disciplines".

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