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ABSTRACTS

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SIMPLE STATISTICS FOR COMPLICATED PROBLEM SOLVING

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Abstract. The purpose of this work is theoretically based methodology to determine the diffusion coefficient in solid body. Using mathematical model of diffusion with constant coefficient, experimental data of weight changes of body and data processing is possible to receive concentration depending diffusion coefficient expression.
Key words: diffusion coefficient, mathematical model, data processing

INTRODUCTION

In order to find optimal drying regime it is necessary to understand the transport mechanisms which take place within and on the surface of the product. The drying process is characterized by the existence of transport mechanisms such as surface diffusion, pure diffusion, capillary flow, evaporation, thermos-diffusion, etc. The mass transfer rate is proportional to the concentration gradient of moisture content, with the diffusion coefficient being the proportionality factor. Determination of the diffusion coefficient is essential for credible description of the mass transfer process, described by the Fick's equation. It is a common practice to describe complete mass transfer with same equation as pure diffusion and take to the correction for the second types of mass transfer into account simply replacing the pure diffusion coefficient with an effective diffusion coefficient.
The situation is different if we look porous layer drying process. With thick layer of materials we need to take into account both the material temperature and humidity variables and drying agent temperature and moisture changing nature. The theoretically based methodology to determine the drying coefficient of porous material is (A.Abolins, 2013)
The aim of this research is to theoretically find diffusion coefficient in solid body using the experimental results of body weight.

RESULTS AND DISCUSSION

In order to determinate the effective moisture diffusion we use the mass maintenance law usually presented in the following form:

$$\frac{\partial \tilde{c}}{\partial t} = div(D\, grad\, \tilde{c}) \qquad (1)$$

D - coefficient of diffusion, $\tilde{c}(x,y,z,t)$ - concentration of moisture in sample, x,y,z – space coordinates, t - time.

Assume the surface of body on the top and bottom directions is greater than in the side direction, the overal diffusion of vapours in the top and bottom is greater than in the side, and we can choose 1-dimentional model with D_x (diffusion in a plane sheet $\tilde{c}(x,y,z,t) \approx c(x,t)$) .

$$\frac{\partial c}{\partial t} = \frac{\partial}{\partial x}\left[D_x \frac{\partial c}{\partial x}\right] \qquad (2)$$

We have a case, where diffusion occurs through all surfaces of the samples and assume that the diffusion coefficient D_x is a constant. In moment $t=0$ concentration of moisture in the samples is constant c_s. The water vapour concentration on the surfaces is constant $c(x,t)=0$. The diffusion process in our case can be considered as a symmetrical situation and we get a mathematical problem:

$$\frac{\partial c}{\partial t} = D_x \frac{\partial^2 c}{\partial x^2} \qquad -l < x < l\,, \quad t > 0 \tag{3}$$

$$c\big|_{t=0} = c_s \tag{4}$$

$$c\big|_{x=-l} = c\big|_{x=l} = 0\,, \tag{5}$$

where $2l$ –sample thickness in x direction .

The problem (3) – (5) with $D_x = D(c) = const$ solution is (Crank, 1956) :

$$c(x,t) = \frac{4c_s}{\pi} \sum_{n=0}^{\infty} \frac{(-1)^n}{2n+1} \cdot e^{-\frac{D_x (2n+1)^2 \pi^2 \cdot t}{4l^2}} \cdot \cos \frac{(2n+1)\pi \cdot x}{2l} \tag{6}$$

If M_t denotes the amount of diffusing moisture which has come out from the material at time t, and M_∞ the corresponding quantity after the infinite time, then (Crank, 1956):

$$\frac{M_t}{M_\infty} = 1 - \sum_{n=0}^{\infty} \frac{8}{(2n+1)^2 \pi^2} \cdot e^{-\frac{D_x (2n+1)^2 \pi^2 \cdot t}{4l^2}} \tag{7}$$

At first we must estimate D_x . Looking at the series (7), we see that it converges very fastand that is why we choose only the first member of the series and expression (7) becomes

$$\frac{8}{\pi^2} \cdot e^{-\frac{D_x \cdot \pi^2 \cdot t}{4l^2}} = 1 - \frac{M_t}{M_\infty} \tag{8}$$

The right-hand sideof the equation (8) is known (experimental data at time$t = t_i$) and the coefficient of diffusion can be expressed:

$$D_x = -\frac{4l^2 \ln(\frac{\pi^2 (M_\infty - M_t)}{8 \cdot M_\infty})}{\pi^2 \cdot t} \tag{9}$$

We can calculate D_x^i for each experimental measurement at time t_i (9) and find constant D_x . Time moment t_i correponds average concentration c_i and using data processing is possible receive corelation $D(c)$.

If D_x is depending on the drying time $D_x = D_x(t)$, we can use the methodology, see (Aboltins, 2013) and find the expression of $D_x(t)$.

It is possible to use difference schemes (Samarskii, 1988) for solving the problem (2)-(5) with the changing diffusion coefficient D(c).

Experimental and calculation results are shown.

CONCLUSIONS

1. The proposed methodology allows finding the variable diffusion coefficient dependence on the concentration.
2. Received D(c) correlations further helps to modelling diffusion process inside different material body.

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MATHEMATICS ADMISSION TEST REMARKS

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Since 2014 there have been admission tests in mathematics for applicants to the Estonian University of Life Sciences for Geodesy, Land Management and Real Estate Planning; Civil Engineering; Hydraulic Engineering and Water Pollution Control; Engineering and Technetronics curricula. According to admission criteria, the test must be taken by students who have not passed the specific mathematics course state exam or when the score was less than 20 points. The admission test may also be taken by those who wish to improve their score of the state exam. In 2016 there were 126 such applicants of whom 63 came to take the test. In 2015 the numbers were 129 and 89 and in 2014 150 and 47 accordingly. The test was scored on scale of 100. The arithmetic average of the score was 30.6 points in 2016, 32.35 in 2015 and 18.84 in 2014. The test was considered passed with 1 point in 2014 and 20 points in 2015 and 2016. The test was designed to evaluate following topics: logical and mathematical thinking, ability to use and understand diagrams, tables, figures and other graphical info; ability to do calculations with planar and three dimensional shapes. For preparation, students were advised to solve problems from extensive version of the state examinations from previous years. In this talk we analyze results from tests and show problems which were solved exceptionally good or not at all.

DEVELOPMENT OF THE GREENHOUSE GAS EMISSION CALCULATION TOOL MITGHGLV

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The agricultural sector is one of significant GHG producer however there are large amount of mitigation measures to reduce GHG emissions from agricultural sector (Cole et al., 1997; De Klein et al., 2001; Majumdar et.al., 2001; Ingram and Fernandes 2001; Goossens et al., 2001; Scott et al., 2002; Wuebbles and Hayhoe 2002; Conant and Paustian 2002; Hampe and Rudkevich, 2003; Boadi et al., 2004; Halvorson et al., 2008; Smith et al., 2008; Wiesmeier et al., 2014; Sheehy et al., 2015; Parton et al., 2015; Sainju, 2016). Agricultural sector in Latvia produce 25% of total national greenhouse gas (GHG) emissions. For the second commitment period of Kyoto Protocol until 2020 Latvia together with other EU member states and Iceland has committed to achieve the joint target of emission reduction by 20% comparing to year 1990 under the 2009 climate and energy package. The national targets, covering the period 2013-2020, are differentiated according to Member States relative wealth. In accordance with EU ESD Latvia's national target is to limit emission growth to +17% above the 2005 level by 2020. (NIR, 2015; EU, 2009). There is need to develop GHG emission mitigation measures assessment tool for Latvian agricultural sector at farming level.

The GHG emission calculation tools are developed for different aims. Colomb et al. 2012 made one of first classifications of GHG calculators which is based on model application approach. Rising awareness category of calculators are built for farmers and farming consultants. Calculators are very simple in use and there is no need to make special training for user. Normally this calculators is built using Tier 1 calculation algorithms (IPCC, 2006; Colomb et al. 2012). Reporting calculators are built on farm or landscape base. The calculation algorithms are based on Tiers 1 and Tiers 2. For example The CLIMAGRI ® tool was originally developed in 2009 by Solagro and Bio Intelligence Service on behalf of ADEME. It is essential to create a dynamic territory and to launch a territorial approach: the diagnosis is not an end in itself and must be part of a longer-term arrangement. The CLIMAGRI ® approach is thus a place in climate maps which it may be the agricultural component.Landscape calculators are mostly used for (IPCC, 2006; Colobmb et al.2012). Farm based calculators are built for farmers to implement GHG emission reduction strategy (Colobmb et al.2012). Project evaluation calculators mostly are developed to compare eventually project gains with current situation. Subgroups of this GHG calculation tools category are selected by carbon market orientation. Market and product oriented calculators are built to provide GHG emission reduction per product and the mine aim is to calculate GHG per production unit.

The greenhouse gas emission calculation algorithms are developed for different calculation purpose to solve some particular aims. The scale of greenhouse gas emissions calculation differ from farm level to country level. The aims of calculation tools variate from scientific research to farmer information and support. The mathematical algorithms of greenhouse gas emission calculations variate from ecosystem based conceptual models to simple calculators based on IPCC default approaches.

The goal of this research is to highlight differences between several greenhouse gas emission calculation tools. This paper describe greenhouse gas emission calculation tool MITGHGLV which developed by Latvia University of Agriculture. The calculator is developed as support tool for farmers to calculate greenhouse gas emission reduction potential by implementation greenhouse gas emission mitigation measures. This paper describes scientific base of calculator and highlight calculation of greenhouse gas emission mitigation measures.

CONCLUSIONS

Farm level GHG calculation tool is useful not only for mitigation calculations bu also can be used as teachin tool for students and farmers to undersatand GHG emiision produsing at farm level and identify mine sources of GHG emissions. The future development of model is related with additional mitigation measure integration in model algorithm.

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CREATING CAREER COMPETENCIES IN OUT OF PROGRAM ACTIVITIES

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Introduction. Almost in every class there is a pupil that wants and is able to acquire mathematics extendedly. Questions might appear for pedagogues:

- Should pupils be given a chance to learn more? Why?
- What should pupil be offered to learn?
- What form of studies to offer?
- What could be the possible mistakes during the learning process?

Aims and tasks. Promote pupils' interest in mathematical problem solving to create skills and abilities in non-standard task solving.

1. Non-standard mathematical task solving in connection with pupil's real life experience;
2. Create learning environment, using IT
3. Prepare the most skillful pupils for successful participation in Olympiad of mathematics.
   Mathematics is one of the base subjects of the study program of school, teaching it is a complex task, because amount of the acquired study topic is wide, which, whereas, requires great effort and regular work from pupils.

Olympiad of mathematics. Olympiads of mathematics were originated in Hungary at the end of 19th century. In 1894, Hungarian Physics – Mathematics association organized mathematics Olympiad for the graduates of the gymnasium. Since then, this Olympiad has been called Etvosh contest, later, Kurshac contest, with short breaks it is being organized every year. Origins of the mathematics Olympiad for secondary school in Latvia go back to 1945/46 academic year, when department of mathematics of State university of Latvia (now University of Latvia) organized first Olympiad. This kind of contests for students happen regularly since 1949/50 academic year, but numeration of Olympiads begin with 1950/151 academic year, when in the organizing it participated also castle of Pioneers of Riga (now Castle of Students of Riga).

In later years, stimulated by the ministry of Education, Olympiads covered whole Latvia. For several years, 3rd and 4th parts of the Olympiads are organized by A. Liepa NMS of University of Latvia. Many years UL professor Agnis Andžāns prepared the sets of tasks for all parts of the State Olympiad of mathematics. Beginning with 2009/2010 academic year, sets of tasks for State Olympiad of mathematics are created by specially created commission.

RIMS Meridian Mathematic competition (MMC) Olympiad. Private primary school "RIMS – Riga International meridian school" organized Olympiad already for the fifth time. Initiator of the Latvia-wide Olympiad of mathematics is the founder of the school „RIMS – Riga International meridian school Ltd" chairman Sinan Ciftler.

„Pangea" Olympiads of mathematics are based of mathematical tests and RIMS Meridian Mathematic competition (MMC) happens in a similar way. Pupils prove their mathematical skills in 80 minutes, solving 34 test type tasks and one open type task. There are maximum 120 points in the Olympiad. Olympiad is available and is led in Latvian and Russian, according to children native language. Pupils from form 3, 4, and 9 took part in this year mathematics Olympiad.

In the Mathematical contest - game "Kangaroo". On 20th March pupils from Latvia together with students from around the world competed in an international mathematical contest – game "Kangaroo", to check their mathematical knowledge. Without previous

selection, any pupils from form 2 to 12 could take part in the contest. Tasks were created in Latvian, Russian and English. The origin country of the contest is Australia. Its realization and idea is owned by famous Australian mathematician and pedagogue Peter Halloran.
The main goal of the contests is to make Mathematics more attractive and interesting. This aim was supported by many teachers from around the world, but the most important thing is, contest was enjoyed by contestants themselves, and it spread really fast around the world.
43rd Open mathematics Olympiad of Latvia. Open Olympiad of Latvia is a place, where everyone stands on one start line, regardless of the prosperity of parents and their native language, place of inhabitant, size of school or identification. Especially for region youth it is a possibility to show ourselves, reaching for further success, is it getting in their dream university, own business or position of the President of the country? There are 5 tasks offered in the Olympiad, for each task they can get 0 – 10 points
International Student Scientific Mathematical Olympiad. Promoting interest about mathematics and furthering creativity, on 27th February, in Lithuania, International Student SCIENTIFIC Mathematical Olympiad (HSPSMO) took place for the fifth time, which was organized by Siauliai University in cooperation with department of mathematics of LUA. This year Latvia was represented by twenty pupils from Jelgava Spīdolas grammar school, Jelgava secondary school of technology, Jelgava secondary school No 5, Ozolnieki secondary school and Kalnciema district secondary school, as well as, one pupil from Jelgava elementary school No 2. The aim of this Olympiad was to acknowledge those pupils who like exact sciences and who are gifted in mathematics, also to motivate them in further career in this field.
International Mathematics Olympiad for students and pupils. Students from four Universities of Latvia and students from Siauliai university, as well as pupils from Jelgava and Ozolnieki were gathered on 16 March in the Castle of Jelgava already a traditional International Mathematics Olympiad for students and pupils organized by department of Mathematics of LAU. This year there was a wide range of participants. Parallel to Olympiad, there was a seminar – discussion, where teaching staff from universities, who teach mathematical subjects in a study process, met. Current events in teaching mathematics were discussed in the seminar. Olympiad consisted in two parts. In the first parts there was an independent work, but in the second part, there was a group work. Greater attention was paid to group work. Participants of the Olympiad were divided in groups. Each group was given a problem, which had to be solved and presented. As the greatest part of the participants were Lithuanians, it was necessary to have good English skills in the group work. Presentation was also held in English. Group work connected with mathematics is a very effective method in mathematics, because it teaches to cooperate, make decisions, from which, whereas, accomplishments of all group depend on. The goal of Olympiad was to promote the interest of mathematics between youngsters, giving a creative opportunity to use it, promote cooperation between young people with similar interests. That is why to take part in the Olympiad were invited those who are very good at mathematics, who are interested in solving mathematical problems, as well as, all those who wanted to try out their abilities in the mathematical contest.
Conclusions. Schools and teachers can in a great way promote pupils' interest about mathematics and becoming passionate about it, as well as, give a greater meaning to studying this subject. Nowadays society very often speaks about schools using old methods to teach pupils, children are bored and they lose interest. I think it is because new generation children are different – more provocative, confronting, intuitive, sensitive, spiritual, and in separate cases, more aggressive than previous generations.

RESEARCH WORK AS A TOOL IN BUILDING MATHEMATICAL COMPETENCIES OF STUDENTS AND THEIR TEACHERS

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We should know that there is no **definition** of a competence or particularly a mathematical competence, in the mathematical sense, what we have they are only more or less good explanations, descriptions. We can find in literature many good theoretical pieces of advice, guidelines, lists of particular competencies, see e. g. [1] – [4], but when we face more or less a serious mathematical problem, they are of a little help, because all the same it is not clear how to use these guidelines for our concrete problem. If such guidelines would help then mathematics would not have unsolved problems being dozens or hundreds of years old.

Unsolved problems serve as a driving force in the development of mathematics. A lot of valuable recommendations for teachers how to choose a research project one can find in [3]. For example: "*The worst choice for a research project is a well-known, unsolved problem. When students start talking about Goldbach's Conjecture or some other problem that has stumped mathematicians for years, I encourage them to begin their research career with a more productive endeavor.*" Any research at the school level should begin with a small, accessible investigation that highlights the stages of doing research. Although students can, and should, acquire skills of doing mathematics individually, the skills are best understood and appreciated in the broader context of doing mathematical research under supervision of the experienced teacher. The mathematical training of teachers, their mathematical background, the ability to check and evaluate pupils' contest papers are far from being sufficient. A grave problem (at least in Latvia) is a lack of teachers who are able to supervise good research work of their pupils. The role of experienced teachers with solid mathematical background can hardly be overestimated [4]: "… these teachers see the links between different mathematical topics and make their students aware of them. Teachers with deep understanding are also more able to excite students about mathematics."

As a good example of school level research topic as well as useful to examine how theoretically defined competencies work in practice we propose the new problem of the determination magic n-gones. Here by *a magic* n-gone we mean a squared or triangular polygon (a polyomino or polyiamond respectively) with all the distinct whole sides: 1, 2, up to n. It is rather easy to state that all the squared magic polygons have even number of sides. Prove or disprove that for each $n \geq 5$ there is a magic triangular n-gone having its sides in the increasing order: 1, 2, ..., n.

A short overview of the contest papers in mathematics presented at the national level in 2016 by pupils of Latvia will be given in this paper.

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THE ANALYSIS OF RESIDENTS' INCOME AND ITS DETERMINANTS IN THE COUNTIES OF LITHUANIA

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In our talk we will discuss about the problems of distribution of residents' income. The poorer the country, the more painful inequality between poverty and wealth is observed. High differentiation of income slows down the economic growth and development. The theoretical part of the talk deals with the structure and sources of residents' income; income is defined both as an index reflecting individual's or his/her family's consumption possibilities and as an indicator of national social economic development as well as society development. Essential determinants of the volume of income are singled out.

The research studies suggest that the volume of residents' income is significant to the quality of residents' lives, common social and economic development of the state. In Lithuania, inequality of income is a huge problem. There are quite insufficient research studies dealing with differences in income across the counties of Lithuania; there is also lack of diversity of methods for this research field. This is the reason why in the talk we will analyse the disposed income per one household member per month, the average net salary per month, the level of unemployment, the gross domestic product and the direct foreign investment per capita. Moreover, the tendencies and differences of the changes across the counties of Lithuania are dealt with, too. Aiming to compare residents' income, methods of descriptive statistics have been applied: relative values, major statistical and basic indexes to estimate changes have been calculated. Cluster and regressive analysis of counties according to economic determinants has been carried out using the SPSS statistical package. The hypothesis of the scientific research formulated by the author has been proved: the structure and dynamics of residents' income in different counties of Lithuania is attributed with high differences determined by such factors as the level of unemployment, the gross domestic product and the foreign investment per resident.

It has been found out that throughout the period of 2004–2014 the disposable income and determinants, i.e. the gross domestic product and the direct foreign investment per capita, had a tendency to increase, the level of unemployment reached the primary level of the period under analysis and even decreased. There exists regional differentiation of residents' disposable income. In the structure of disposable income, income from hired and self-employed work constitute the biggest part of income, even though throughout the period under analysis this part significantly decreased, whereas a part of social allowances increased. A common situation in the counties is undergoing improvement according to the volume of disposable income because the difference between highest and lowest income at the beginning of the period and at the end of the period decreased from 52 to 33 per cent.

What concerns disposable income, the average net salary per month, the level of unemployment, the gross domestic product and the direct foreign investment per capita, counties can be united to the following clusters: lagging behind – Alytus, Panevėžys and Šiauliai counties; in pursuit – Marijampolė, Tauragė, Telšiai and Utena counties; advanced – Kaunas and Klaipėda counties; leading – Vilnius County.

Social and economic differences among counties of Lithuania exist; therefore, different models of disposable income with its determinants are presented for all the counties. Disposable income are closely related to the direct foreign investment and the level of unemployment in Tauragė County only; related with the gross domestic product and the direct

foreign investment in Marijampolė and Šiauliai counties; other counties depend on the gross domestic product and the level of unemployment.

Both uneven development of Lithuanian economy and increasing differences of residents' income slow down the common economic growth and cause social problems in majority of the counties. Real and functioning, economically reasoned regional policy is still being hardly implemented in the state.

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AMORPHYSATION MATHEMATICAL MODEL

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To describe the kinetic equation

$$\frac{\delta n_i(x,t)}{\delta t} = G_1 + G_2 + T_1 + T_2\text{-}A_1\text{-}A_2 \quad (1)$$

we add an additional member G_2.
There $n_i(x,t)$- interstitial density variation rate, G, T, A- the generation, handling and annihilation components.
This equation can be solved only when it is analytically simplified. In equation we eliminate T and A, because irradiation destroys dislocation. Without these components the equation is becoming a simple differential equation:

$$\frac{dn_i}{dt} = F_n n_0^{-1} j(n_0\text{-}n_i) + \alpha n_i\text{-}\beta n_i n_V. \quad (2)$$

The vacancy and interstitial recombine together so $n_i = n_V \equiv n$:

$$\frac{dn}{dt} = F_n n_0^{-1} j(n_0\text{-}n) + \alpha n\text{-}\beta n^2. \quad (3)$$

Found a new variable, i.e. $d\Phi = jdt$ ir $C = nn_0^{-1}$ (C- concentracion of defects):

$$\frac{dC}{d\Phi} = F_n n_0^{-1}(1 - C) + \alpha j^{-1} C\text{-}\beta n_0 j^{-1} C^2. \quad (4)$$

Conclusion: this diffuse amorphysation way is associated with accelerated diffusion of interstitial space between concentrations. Compliance statement, that the interstitial space works with the density of defects and stress gradiens associated power. Defunded because of the concentrations the interstitial space makes amorphysation of the cell faster, because it reduce the interstitial space and vacancy probability of recombin

THE DEVELOPMENT OF CONCEPTUAL MODEL METQ AND INTEGRATION IN STUDY PROCESS

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The growing world population leads to higher urbanization and changes of watershed structure. The aim of this research is to highlight the necessity of urban dimension integration in the conceptual model METQ. The conceptual model METQ is build for rural areas however it cannot be used for watershed with urban areas. The integration of urban dimension in the model structure has been made during the last years. Model takes in to account not only runoff but also the water flow from sewage water treatment plants. The regional hydrological models become more and more important in changing land use and climate conditions. This paper presents first version of integrated METUL and METQ models named METQ-UL with auto calibration feasibility and graphical interface. Early versions of models were developed for pure natural areas. However by fast urbanization of natural areas there is need to apply this land use dimension in hydrological models. As new component of model METQ-UL is integrated urbanized sub basin option.

Similarly to previous versions of the model METQ, the METQUL2012 is applied in the simulation of the daily runoff of rivers with different catchment areas. Sufficient or even good coincidence between the observed and simulated daily discharges was obtained.The results show strong evidence that integrated urban hydrological response unit gives significant improvement of model results for urban areas.

The conception of the the model METQUL2012 for the point scale is shown in Fig. 1. A more complete description of the model is presented by Krams and Ziverts (1993). The land surface in the METQUL2012 is represented with three layers. The upper layer is called the root zone and it does not have a precisely defined boundary. The primary mass of vegetative roots are found in this zone and evapotranspiration in the root zone during the period of vegetation is determined primarily by plant transpiration. The lower layer is the groundwater and capillary fringe zone which is divided in two sublayers.

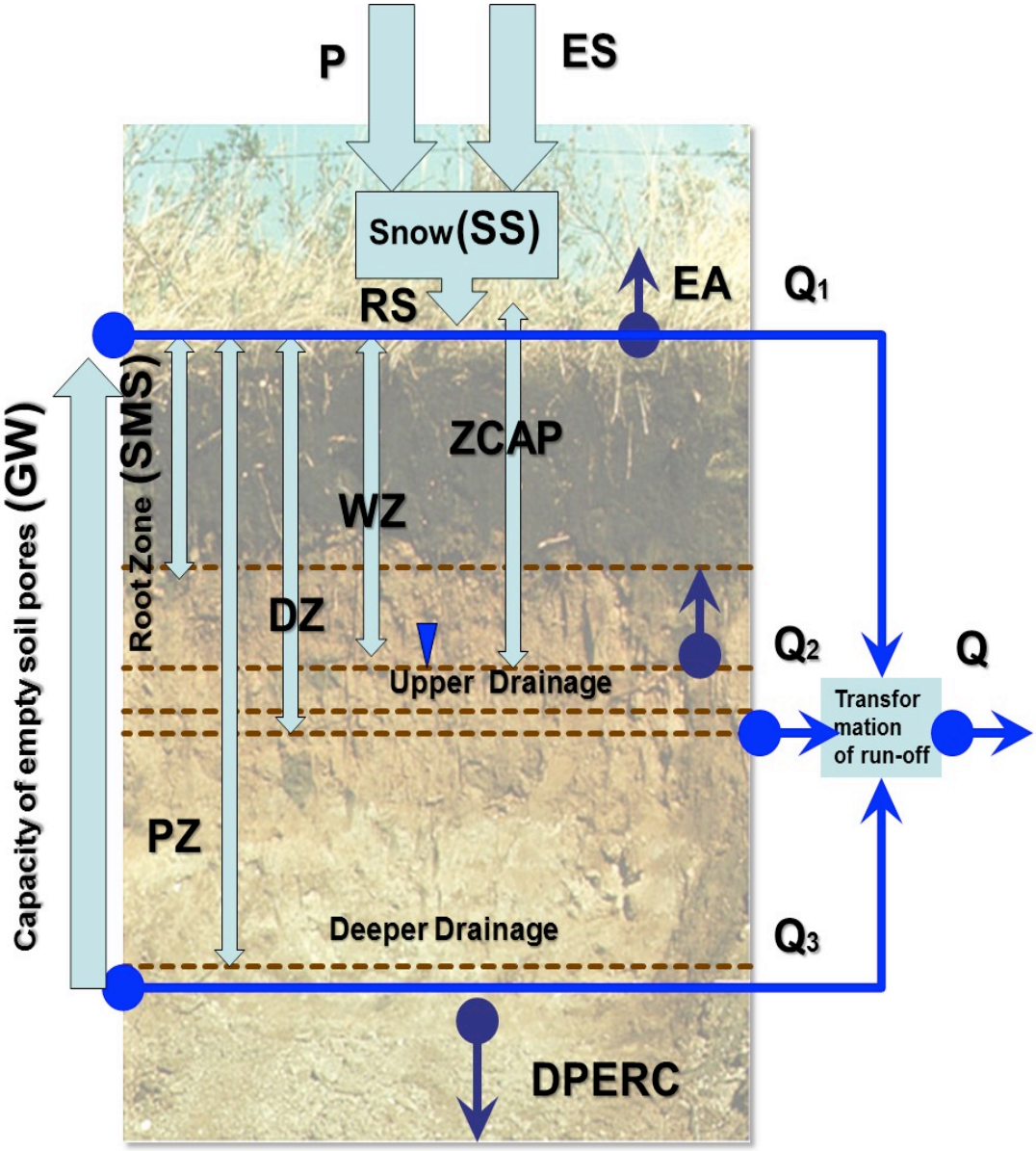

Figure 1 **Conception of the model METQUL2012**

The flowchart of METQUL2012 is presebted in Figure 2. In red is presented urban hydrological response unit which is integrated in the model.

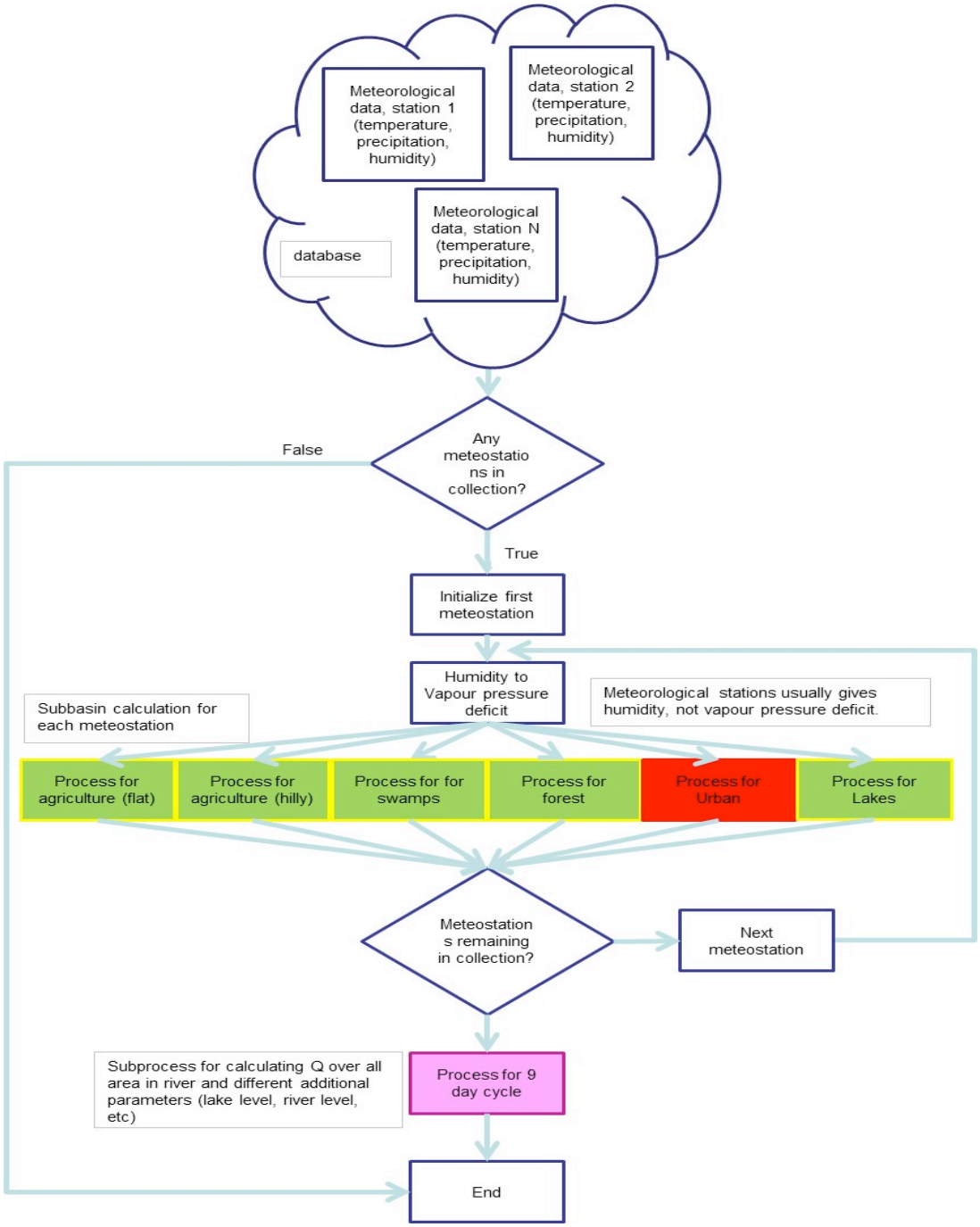

Figure 2. The flowchart of the model

Conclusions. The conceptual model METQUL2012 is useful not only for modeling of hydrological process but also as teaching tool for students and stock holders. The future development of model is related with additional module development for environmental modeling.

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THE CORRECTNESS PROBLEMS IN APPLYING INDUCTIVE STATISTICS IN ECONOMICS AND AGRICULTURE

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In the article "Professor Tinbergen's Method" (Keynes J. M. Professor Tinbergen's Method. − The Economic Journal. 1939. Vol. 49. No. 195) John Maynard Keynes expressed critical notes concerning insufficient scientific level of the Jan Tinbergen's results obtained with the help of econometric methods about the factors influenced by volume of investments [1, 2, 3, 4].
Our research shows that the critical appraisal of econometric applying given by John Maynard Keynes in 1939 completely can be assigned almost to the all published in Latvia research in economics done by inductive statistics because scientists careless by apply the linear regression model in absence of the knowledge *a priori* required by proper theorems and algorithms used in the computer-programs. Moreover, many times it is no sense even to speak about stochastic experiment because the most important condition − *ceteris paribus* does not fulfil, namely, economic environment is not homogenous enough. As the result, the careless utilizing of econometric theorems leads to the epidemic of the non-scientific "scientific papers" in Latvia.
The paper [5] actualizes the critical notes expressed of John Maynard Keynes.

Didactical experience of the authors during many years witness that business administrators and even economists do not understand the concept of induction and its role in the positive deductive science. Experimental tests confirm us that because of poor mathematical culture many researchers are not able clearly separate descriptive statistics from inductive statistics.
Indeed, if studies of mathematics are not enough for rigorous understanding, for example, the essence of limit of sequence of numbers then later it will be impossible to understand exactly the concept of limit by probability of random numbers sequence basically used in inductive statistics. For instance, if any person does not understand deeply the equality $\lim_{n\to\infty} \frac{1}{n} = 0$, then it is absolutely impossible for this person to understand the sense of famous big numbers rule (Daniel Bernoulli) $\lim_{n\to\infty} W_n = \zeta$ [6, 7].

As illustration of totally non-critical application of regression model we can mention the calculations and conclusions carried out nowadays in Latvia with the help of well-known Z-score bankruptcy forecasting model given by Edward I. Altman:
$Z = 1{,}2\ T_1 + 1{,}4\ T_2 + 1{,}2\ T_1 + 3{,}3\ T_3 + 0{,}6\ T_4 + 0{,}999\ T_5$,
where T_1, T_2, T_3, T_4, T_5 are relations often utilized in the firm's financial analysis.
How unforgivingly far from true scientific investigation are the authors and their article reviewers what assume as suitable the application of the Z-score model, derived in USA in 1968 and based only on 66 observations, as a miracle-tool in Latvia, 2014. They openly ignore the times, the country, and another circumstances.

Generally speaking, for inductive purposes it is almost impossible to apply correctly regression models in macroeconomics because "the ceteris paribus" condition usually does not hold. Sufficiently better is the situation in the field of scientific econometric researches in agriculture − agrometrics. Similarly like in biometrics doing some kind of statistical research in agriculture it is possible to organize scientific stochastic experiments that correspond to the proper theoretical conditions, namely, to be sure that the most important condition − *ceteris paribus* fulfils, and environment of phenomenon is homogenous enough.

We can find many successful applications of theorems of inductive statistics as tool in decision analysis in agriculture, for example, in papers of J. B. Hardaker, G. Lien, J. R. Anderson, and R. B. M. Huirne [8]. The book "Coping with risk in agriculture: applied decision analysis / J. B. Hardaker, G. Lien, J. R. Anderson, and R. B. M. Huirne" contains a lot of references on successful investigation in agrometrics.
The are also more close examples. For instance, some successful investigation in agriculture provided with the help of inductive statistics were reported in the Section of Engineering during 15th International Scientific Conference "Engineering for Rural Development" provided by Faculty of Engineering of Latvia University of Agriculture, and Latvia Academy of Agricultural and Forest Sciences.
To the authors' opinion the effect of management practices on time spent by cows in waiting area was suitably investigated in paper [9] and deductive conclusions were obtained rather valid with the help of mathematical model based on inductive approach.

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AGROMETRICS NETWORK OVER THE YEARS

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The idea to create the Baltic and Nordic Agrometrics (*mathematics and statistics in higher agricultural education and research*) society rose during that meeting in June 1998 with a view to identify the kind of mathematical education needed, enhance the quality of learning through the exchange of lecturers' experience and review the use of learning methods and mathematical modelling techniques in agriculture.
The purpose of this cooperation was the necessity to understand what kind of mathematics and what amount of it agriculture specialists need as well as to achieve common standards in higher agriculture education. The other reason of this cooperation was to improve the teaching quality by means of exchanging teachers' experience, to learn about the problems and methods used to solve them in the neighbouring countries.
With increasing number of students who continue training in other European universities in various exchange programs, such cooperation becomes essential. Study programme coherence is an important factor in the common European education area.
The original idea has proven to be not quite viable for financial reasons, as well as lack of organizational structure and strong leadership to coordinate these institutions and to mobilize resources to achieve its goals. In the Sixth Agrometrics conference, held in 2008 in Kaunas, Lithuania, was updated the development issues of current mathematical and statistical studies in the Baltic and the Swedish Agricultural universities, and began discussions on continuing cooperation in the field of Agrometrics in desired shapes and forms. The seventh Agrometrics conference's held in Jelgava, Latvia, 22 to 23 April 2010, main task was to develop the future cooperation framework in the field of mathematics and statistics for Baltic Agricultural universities as well as to create working group to coordinate this cooperation. Department of Mathematics, Latvia University of Agriculture, is the network coordinator since 2010.
The aim of this article to shed some light on the problems encountered in Baltic and Nordic Agricultural universities in the field of Agrometrics and progress achieved during eighteen years. It should be also noted that it is already tradition that the organizer of the Agrometrics conference summarizes past experience and put it on, thereby maintaining idea of Agrometrics society - network (Table 1).

Conclusions

- In summary, eighteen years' cooperation in Agrometrics of the Nordic-Baltic so called universities of Agriculture the scholars and scientists in these universities had the opportunity to meet, to discuss current problems and find common solutions and share experiences, course descriptions and literature lists have been exchanged among the countries.
- Common diagnostic tests have been created and used for students in several of participating countries.
- This cooperation has provided the opportunity for teachers to visit other universities for exchange of experience, for professional development and for training purposes.
- It should be noticed that the statistical consultancy it is still a problem in the Baltic States and it needs close cooperation with Nordic countries for developing it.

- The perspectives include the common research on role of Agrometrics studies in agriculture education and realization of what must be changed in mathematics and statistics studies programs as well as several organizational aspects of Agrometrics studies process e.g. the approaches to develop cognitive development of students, math didactics, e-learning, cooperation of participants of agriculture education, promotion the development of the competences necessary for sustainable development, work with gifted students etc.

Table 1.

Data about Nordic-Baltic Agrometrics conferences.

No	Venue	Main results
First	Kaunas, Lithuania September 25-26, 1998	·The term "Agrometrics" was proposed as a summary for mathematics and statistics in the agriculture sciences; ·Formation of a five-person contact group to maintain contacts for teachers of mathematics, statistics and data processing at the Agriculture universities in the Nordic and Baltic countries.
Second	Karaski, Estonia September 23-25, 1999	·Common standards in mathematics and statistics in Nordic and Baltic countries; ·Decision about using common diagnostic tests for students in several of participating countries; ·The idea of creation the "Agrometrics journal" to publish papers on teaching and research issues regarding Agrometrics.
Third	Jelgava, Latvia May 24-26, 2001	·Discussed the results of diagnostic tests; ·Decided that the Swedish students have some advantages in solving practical and applicable tasks whereas Baltic students were stronger in solving ordinary elementary mathematics; ·Cooperation on textbooks and teaching materials and exchange of course description; ·The development of the mathematical modelling syllabus at Bachelor's, Master's and Doctoral studies; ·Organizing the statistical consultancy in the Baltic States.
Fourth	Uppsala, Sweden June 15-17, 2003	·Discussions decreasing mathematics level among the students and the necessary changes in mathematics study programs; ·Study programme „Biometrics" was proposed by Latvia University of Agriculture as an international study programme for all Baltic countries – Latvia, Lithuania and Estonia.
Fifth	Otepaa, Estonia, June 15-17, 2005	·Discussed mathematics and statistics teaching issues; ·Decisions on mathematic modelling problems.
Sixth	Kaunas, Lithuania June 18-20, 2008	·The work of five-person contact group was over; ·Discussed Agrometrics society - network role in agricultural education and its leadership, as well as financial issues; ·Decided to organize the Seventh Nordic-Baltic Agrometrics conference in Latvia, seeking new forms of cooperation.
Seventh	Jelgava, Latvia April 22-23, 2010	·Main focus to technology enhanced teaching and learning mathematics and statistics, e-learning, blended learning, virtual learning environment; ·Management of the mathematics and statistics studies process;
Eighth	Tartu, Estonia, May 10– June1, 2012	·Practical Problem Solving in Mathematics; ·Statistics in student research and studies; ·Discussed statistical consultancy coordination.
Ninth	Kaunas, Lithuania, June 14, 2014	•Discusses management of the mathematics and statistics studies process •Presented ICT usage in teaching and learning mathematics and statistics; ·Presented latest theoretical ideas in mathematics and statistics; ·Physics and Informatics joined the network.

THE SHORT COURSE OF MATHEMATICS: HOW TO TEACH?

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Mathematics is one of the fundamental sciences and has applications in many academic fields. It is a compulsory subject for the first year students at Aleksandras Stulginskis University. Depending on the speciality Mathematics can be taught for only one semester (short course) or two-three semesters (engineering specialities). There is a tendency that while creating the new study plans, the contact time is reduced, and some of it is given to the self-sufficient students' learning. Also the number of credits in mathematics is reduced and it is intended to combine the two subjects: Mathematics and Information Technology. Thus 7 study programs have study course "Mathematics and Informatics". The subject of this study is equivalent to 6 ECTS credits (i.e. 160 hours). During the semester Mathematics (3 ECTS credits) has only about 12 hours of lectures and 19 hours of practical works. The 7 agricultural specialities have a short course for studying Mathematics. However, this course is quite extensive. It includes the basic topics of mathematics and it has its learning continuity.
Last year a short course was taught using mini-tests method. The main purpose of this method is to have a consistent learning of students and always check the level of their learning. Mini-tests method was included into Mathematics subject and taught for 8 groups of students of study programs of Faculty of Agronomy. Each week there was a new mathematics topic and students were given an individual work. During the practice hours mini-test is given for the last 20 minutes from the topic of the previous week and students must submit their individual works. During the mini-test students can use a formula sheet, lecture notes and other mathematical literature. Mini-test is evaluated for 1 point and the average of mini-tests has 10 % impact to the final evaluation of Mathematics course. Lecturers check individual works and mini-tests each week and analyse mistakes done by students. This methodology trains the internal discipline of students which is needed during the first year of studies. In the end of the semester there was a survey given to students in order to know their opinion on mini-tests, the amount of time spent on self-studying, its efficiency, and the usage of mathematical literature. There were 156 students (53.2% males and 46.8% females) which participated in the survey.

Conclusions

1. While teaching mathematics, we see a contradiction between the new tendency to increase individual hours for students to study at home and students' inability to study individually. The teaching methodology is needed for students in order to stimulate their consistent learning, usage of literature, preparation of learned material, and attendance of lectures.
2. The methodology of mini-tests is a very intense work for a student and for a lecturer. The study showed that this methodology guarantees fast learning, good attendance of students, and helps students know their mistakes.
3. There was a material in Moodle environment where solutions of the problems were given in details and with a lot of examples. According to students using Moodle for this subject was accepted and evaluated quite well.

MATHEMATICAL ESTIMATION OF MOBILITY OF PEASANTS IN VILNIUS GOVERNORATE IN THE 19TH CENTURY

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Statistical-demographical data used in various research studies usually is insufficiently informative. Information on the life of governorates in tsarist Russia was collected in "Memory Books" (Памятные книжки Виленской губернии) [2]. The data from these sources has been processed and presented in the study [1]. The study includes a table (see Table 1) (all the data is presented in "Memory Books", the years of publishing are two years later than indicated in the table); it presents general data on the life of peasants, its development. According to the data under discussion, the number of small rural districts remains quite stable, the number of peasants increases, as in parallel the numbers of villages and bartons (homesteads) change, too. However, this information does not tell much because it lacks some logic.

Table 1

General Data on Peasants in Small Rural Districts, Their Development

	Number of small rural districts			Number of villages		
Counties	1868	1872	1874	1868	1872	1874
Vilnius	19	19	19	2,068	2,629	2,454
Trakai	17	17	17	1,114	1,167	1,207
Lida	24	24	24	1,085	1,108	1,092
Švenčionys	24	23	23	1,664	1,631	1,653
Ašmena	23	23	23	1,280	1,383	1,420
Vileika	30	29	28	1,197	1,212	1,222
Disna	24	22	22	1,477	1,522	1,537
In total	161	157	156	9,885	10,652	1,537
	Number of bartons			Number of inhabitants		
Counties	1868	1872	1,874	1868	1872	1874
Vilnius	9,065	9,649	9,433	94,257	97,022	101,620
Trakai	8,584	8,713	7,947	78,060	79,358	85,568
Lida	9,207	9,316	9,246	87,526	90,521	89,949
Švenčionys	9,957	9,789	9,943	89,748	88,474	95,632
Ašmena	12,814	13,812	13,214	104,223	105,605	112,317
Vileika	10,305	10,178	10,161	94,957	94,273	87,972
Disna	10,029	9,392	9,814	95,085	89,216	94,449
In total	69,961	70,849	69,758	643,856	639,469	667,579

The logic appears after a slight transformation of the data (Table 2). The table displays three quite stable numbers: number of inhabitants in a barton – 10 people; number of bartons in a village – 4 units; number of inhabitants in a village – 45 people. Thus, a certain order was maintained in the people's lives.

Table 2

Bartons, Villages and Inhabitants in the Counties

By year	Vilnius County						
	1868	1872	1874	1875	1876	1877	1879
Number of inhabitants	94,257	97,022	101,635	101,644	104,579	109,844	111,117
Number of bartons	9,065	9,649	9,433	8,834	10,248	10,218	10,240
Number of villages	2,068	2,629	2,454	2,352	2,375	2,379	2,379
Number of bartons in a village	4.38	3.67	3.84	3.76	4.31	4.3	4.3
Number of inhabitants in a barton	10.4	10.06	10.77	11.51	10.2	10.75	10.85
Number of inhabitants in a village	45.58	36.9	41.42	43.22	44.03	46.17	46.71
Changes in the numbers of inhabitants		2,765	4,613	9	2,935	5,265	1,273
Changes in the numbers of bartons		584	–216	–599	1,414	–30	22
Changes in the numbers of villages		561	–175	–102	23	4	0

Slight changes in the numbers of inhabitants, villages and bartons (Table 2, three bottom lines) show vast mobility of peasants in villages and bartons throughout the county. Big changes in the numbers of bartons mean the formation of new homesteads of peasants and the neglect of the old ones – people would migrate in parallel, too.

The same situation is also observed at the level of small rural districts.

Conclusions

1. Simple demographic data gives little information; it should be transformed into a specific shape in order to see the numbers of small rural districts, bartons in counties of a governorate; the numbers of inhabitants in bartons and villages; numbers of bartons in villages.
2. High changes in the numbers of villages and bartons across time (every two years) shows intensive mobility of groups of peasants moving from one place to another.

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INTEGRATIVE APPROACH IN THE TEACHING OF GENERAL AND PROFESSIONAL SUBJECTS

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While working with the contemporary youth (becoming pedagogues, engineers, economists etc.) it is important that the material they have to acquire would not be only answered during a test but also would stay in the memory of applicants for a longer time, and they would also be able to use this knowledge in other subjects and in real life.
Since the biggest part of contemporary youth is hyperactive or just opposite – apathetic, it is very difficult to attract attention and even more difficult to keep it, but to make the youth to do all their homework and learn study topics is almost impossible. Therefore, it is important to use maximally progressive teaching methods in order to interest students in the learning process and to gain the maximal result.
These methods could be the use of acting and games in the teaching process as well as the integration of some social science knowledge in the less popular subjects such as science subjects, also fields in which students are more interested (aspects of the future profession, understanding of economics and business) could be integrated in the study subjects.
The integration of technology, mathematics, and science education has been gaining attention throughout each of the prospective fields in recent years, particularly at the middle school level. However, little research has been conducted at the high school level to probe whether an integrative approach to teaching and learning technology, mathematics, and science education is valid and worthwhile or leads to improvements in student learning (Foster, 1994; Wicklein & Schell, 1995). These methods could be used in the teaching and learning of every subject, starting from labour protection and civil defence and finishing with mathematics and physics.
Depending on the profile of educational institution and education level, the teaching and learning with integrative approach should be organised variously. For example, the work that has to be carried out in the general education schools cannot be compared with that one of vocational secondary schools or universities. Due to the current study curriculum and the lesson number dedicated for its acquisition it is impossible, so at the beginning the integrative approach could be used in extracurricular classes or during consultations.
In general education schools lesson number for science subjects is insufficient but in vocational high schools it is a catastrophe, for example, in mathematics it is only 70% of the lesson number in general secondary schools in poor municipalities, and 56% of the lesson number in richer municipalities.
Since the requirements for all high schools are the same, also final graduation exams are identical, a solution should be found as how to interest students in the acquisition of teaching materials since without independent work good results could not be expected. But mathematics and physics are in the basis of all engineering sciences. Economic growth and successful entrepreneurship, also skilfully organised budget cannot be done without profound knowledge of mathematics. Therefore, the authors of the article concentrate their attention on vocational schools.

The integration of technology, mathematics, and science education at the secondary level, taught by either a team of teachers or a single teacher, is a growing national and international

curricular and methodological concern. Significant questions remain, however, regarding the implementation and benefits of integrated TMaSe. (Chris Merrill 2001.)
In the school year 2015/16 on the experimental basis in the second year of college (corresponds to 11th grade in a general secondary school) was carried out an experiment – during consultations students were assigned to do research in which acquisition and use of 3 study subjects was included. The basic subject of the project was mathematics, so despite the speciality, it was the first subject which was included in the research, the second was economics but the third subject was professional depending on the speciality, for example, electronics. Students did the task in the groups of 2 or 3 people. They not only had to write the research but also to present it in the front of their teachers and classmates as well as to participate in discussions, to argument their results and conclusions.

Of course, for a pedagogue preparation for classes, creation of tasks and individual lessons requires incomparably more time and energy than in a classical case, and due to the economic situation of pedagogues it could be seen a "volunteering work".
The article has been made with the purpose to attract attention to the growing problem – insufficient acquisition of mathematics knowledge in vocational secondary schools, and to find some of possible solutions.
In the article, the influence of integrative teaching approach on the students` knowledge level, obtained results and the desire to learn is depicted and analysed.
Key words: integrative teaching, mathematics, methods, results.

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USING THE ANALYTIC HIERARCHY PROCESS FOR GROUP WORK IN MATHEMATICAL MODELLING

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The most famous method for making multi-criteria decisions called the Analytic Hierarchy Process (AHP) are using in mathematical modelling courses as analytic tool of study courses.
AHP was developed to optimize decision making when one is faced with a mix of qualitative, quantitative, and sometimes conflicting factors that are taken into consideration. Decision-making involves the use of intelligence, wisdom and creativity in order for humans to satisfy basic needs or to survive. Evaluating a decision requires several considerations such as the benefits derived from making the right decision, the costs, the risks, and losses resulting from the actions (or non-actions) taken if the wrong decision is made.
AHP uses the judgments of decision makers to form a decomposition of problems into hierarchies. AHP uses matrix algebra to sort out factors to arrive at a mathematically optimal solution. Using pairwise comparisons, the relative importance of one criterion over another can be expressed.
AHP derives ratio scales from paired comparisons of factors and choice options. Typical applications are in:

- evaluating the quality of research or investment proposals;
- selecting desired product components from several vendors;
- prioritizing factors and requirements that impact product development;
- choosing among several strategies for improving safety;
- estimating cost and scheduling options for material requirements planning,

AHP also uses actual measures like price, counts, or subjective opinions as inputs into a numerical matrix. The outputs include ratio scales and consistency indices derived by computing eigenvalues and eigenvectors (The analytic hierarchy process, 1990, T. Saaty).
Students choose a research problem in an individual work. An important part of the process is to accomplish three steps: state the objective, define the criteria and pick the alternatives. In summary, the analytic hierarchy process provides a logical framework to determine the benefits of each alternative. If students work in groups, they can compare their results and to develop the optimal solution from popular or to create a new hierarchy level and use AHP again.

MAKING LEARNING ATTRACTIVE WITH ICT

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In the period from September 1, 2014 till August 31, 2016 Education Innovation Transfer Centre has implemented Erasmus+ Strategic Partnership project "Language learning for screen generation". Several new educational products have been developed in cooperation with partners from UK, Lithuania and Portugal:

- Website in project partners national languages http://xwpx.iipc.lv/screen-en/;
- Toolkit of attractive language teaching: good practice examples, video lessons, tests, description of the methodologies for language teaching, etc. https://www.iipc.lv/skydata/;
- Language teachers network as well as
- Strategies for teaching/ learning languages for Z generation.

Generation Z (sometimes called also "screen" generation) is the most connected, educated and sophisticated generation ever. Generation Z students have grown up with technologies and they expect to be able to find whatever information they want quickly and will often give up in frustration if a solution isn't easily found. They look for educational opportunities that use visually enhanced methods of teaching. Z generation learns differently because of their exposure to technology. It determines that teachers need to build an effective learning environment for students. So any new educational products like toolkits etc. enhance teachers' capacity to work with Z generation.

Although in the framework of the project created educational products are for languages teaching/ learning, they can be transferred to other subjects, e.g., mathematics. First, they are learning platforms, which allow to make the lesson more interesting, e.g., Kahoot, Socrative etc. These are classroom applications for fun, effective classroom engagement, there is no matter where or how is taught, they allow to instantly connect in any language, on any device, for all ages any subject.

Z generation is characterized also by other - they spend too much time on the screen. So, sometimes very necessary directly opposite teaching methods, that is, such that it distracts students from the screen. Several methods were developed by Lithuanian and Latvia partners. One of them the most popular and quite widely used is story telling. It allows to involve people to talk about their experience, share ideas, thoughts and personal views. It is a tool to encourage people to talk to each other and listen as well as train different skills.

In the talk, will be presented the toolkit context, some videos as well as played games.

COMPARATIVE EFFICIENCY ANALYSIS OF AGRICULTURE SECTORS IN EU MEMBER-STATES

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Production economics forms a very important part of an enormous range of economic theory. Agricultural production is no exception. Data Envelopment Analysis (DEA) has become a popular method for measuring efficiency. This method assigns an efficiency score to each decision making unit based on how well it transforms a given set of inputs into outputs. This paper provides an examination of the applicability of DEA method to agriculture sectors efficiency measurement. Two similar but different concepts–efficiency and productivity– as well as their application to the agriculture sectors production of EU members as the decision making units. When evaluating the competitiveness of the multifunctional agriculture, it is necessary to use the measure of efficiency instead of productivity. The paper addresses the question of the evaluation of efficiency in the agricultural sectors of the European Union. The conception of the efficiency is explained and the methods for measurement are provided. The authors discuss the methods of stochastic analysis (SA), Free Disposal Hull (FDH) analysis and DEA that are particularly useful for multi-criterial evaluation of multifunctional processes. Data from the European Commission databases collected during 2005-20015 were used. By applying a mathematical model, which is based on the DEA, the efficiency of an agriculture in each EU country was evaluated. The results show that agriculture of new EU countries, including Lithuania, is still poorly effective, even though the efficiency tends to increase. The main factors that could increase the agricultural efficiency in Lithuania are the use of cheap labor force and sophisticated agriculture machinery. The conclusion drawn from the paper is that, subject to some quite significant caveats, DEA is a potentially powerful approach to the evaluation and comparing the efficiency of different agriculture sectors performance with the similar production functions.

COURSES ON MATHEMATICAL MODELLING IN MASTER'S LEVEL PROGRAM

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In 2014, the Department of Agricultural and Production Engineering at the Institute of Technology at the Estonian University of Life Sciences faced with a problem of shortage of students at the Master's level. Students explained that they have no reasons for considering graduate studies. The primary cause of low motivation lies in the fact that the number of occupations that require a master's degree in Estonian job's market is very small. In addition the curriculum for agricultural and production engineers contained too many specific courses which will not be useful to be eligible for more jobs.

The first steps in attracting more students were revising the Master's level curriculum and explaining career possibilities after graduation. New curriculum contains two mathematical courses: Mathematical Modeling for Engineers (4 ECTS) and Finite Element Method (5 ECTS). These courses provide an overview of the different modeling approaches, languages, techniques; create opportunities for students to conduct research using modern methods of mathematical applications.

From 2015, the number of students that choose to study agricultural engineering has increased significantly. Students realized that new courses, including mathematics, allows to become more competitive in the job's market.

MATHEMATICS EDUCATION PROBLEMS AND SOLUTIONS FOR NOWADAYS SCHOOL

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Decreasing the number of population strongly influenced education system in the country. There are not so many school-age children, that all schools would filled which acted 7 years ago. Some of them are necessary to close. The teachers are leaving without jobs, students have to choose other educational institutions. Schools for us is as educational services provider. All this leads to schools competition because each school trying to survive. Schools are looking ways to become exclusive, attractive to pupils and students' parents in order be not closed. As a result there appears different school's kinds: art, sport, a catholic school, military nature, secondary school, lyceum and etc.

According to William Strauss and Neil Howe'o theory, every 20 years, grow a new and unique people's generation - formed by that period crisis, the ups and breakthrough technology, which is determined people's worldview, personal values. Now schools filled a generation of Z children, according to generation theory. This generation does not like coercion, strict rules, restrictions. They want to be exclusive people. Educators have a difficult task to teach such pupils. He needs to interest students to lesson and submit the topic innovatively. The tutorials comes to the rescue teacher, but there is offered a few different series of mathematics textbooks. The question is: by which mathematics textbook we can achieve the highest mathematics knowledge result of the math teaching.

Despite the fact that there are different types school, that they teach from different series mathematic textbooks, a general education mathematics program is the same for all schools and all students keep the same mathematics exam.

Since 2000 years ago was started profiled education. It provided an opportunity for students to choose a subjects to learn (whichever level) and to choose keep a state exams, which they want (except Lithuanian language, because it is required). For long years, pupils have used the opportunity to avoid math exam and the bigger number of math lessons, as a result and mathematical knowledge level dips. The Ministry of Education noticed this problem and took into account to complaints the high schools due to the low level of mathematical knowledge, so they has taken steps to promote pupils to choose subjects and exams more responsibly. Thus, from 2016 years graduates can pretend to study to state-funded places at university if they have passed mathematics maturity exam (it is not necessary for art's studies).

THE STUDENT'S PERFORMANCE AT THE UNIVERSITY DEPENDING OF SECONDARY SCHOOL MATHEMATICS EXAMINATION RESULTS

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There have been made several reforms in Estonian education during the last years – elementary school and high school were separated, the programmes were changed, the high school state exams conditions were changed. The students of mathematics in high school learn choose between the wide or narrow cource. The exam of mathematics is now obligatory there were the lectors prefere the students are well prepered and successful with their studies. At the present paper there supervising the progress of the students in the University in the ligth of the final exams in the high school and the results of the test in the University first lecture.

Keyword: advanced mathematics, the results of different level of mathematics education

COMPARISON ANALYSIS OF STUDENTS' DROPOUT RATE AT LATVIA UNIVERSITY OF AGRICULTURE

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The university dropout is an important topic in many countries, as well as in Latvia, because it is one of the criteria for evaluating Higher education institutions and students' dropout can be flawed measures of institutional effectiveness. Higher education institutions may increase the number of graduation students and goes in the direction to reduction of study standards.
The present study analyse the first study course students' dropout rates in higher education institutions, using the real data of engineering study program in Latvia University of Agriculture (LUA). Proportional hazard model of Survival analysis was used for data analysis. Students' study duration (month), age, gender, secondary school grades, priority to study in the program (first, second, or third) and the finance source (budget or self-finance) were included to the model us factors which can influence students drop out rate.
As shown our study in 2012 the number of students decreases over time and the censored students' proportion after the first study year is 64.1%. During the first academic year 34.4% of students leave the University. Students' dropout risk is associated with Faculty or subject studied at University and study program curriculum. The number of students enrolled to the University in different faculties has decreased over time, and at the end of the first academic year, from 24.3% to 51.6% of students left the faculties at the University. Students with a higher proportion of dropping out are those who enrolled in Faculty of Information technology (51.6%) and Faculty of Food technology (47.7%), whereas the students of Faculty of Engineering have the highest rate of studying students. At LUA in engineering study program curricula contains such topics as mathematic, physic and chemistry and it influences the dropout among the students. The results of this study show finance group ($p<0.05$), priority ($p<0.1$) and school mark ($p<0.001$) factors are the main causes for students' dropout at the University [1].
In 2016 published investigation were analysed data of full time engineering science student which enrolled in 2012, 2013 and 2014 year at the LUA. There is difference between year and students dropout range from 7.0% in 2013 and till 39.6% in 2012. Male students have the highest rates of leaving the faculties; as well the students' dropout depends on the faculty. Censored students' proportion after the first study year in 2012-2014 is 74% at the engineering faculties and during the first academic year 26% of students leave the University. The results of this study show students' dropout risk is associated with year ($p<0.001$), where dropout rate was higher in year 2012 (39.6%) and lover in year 2013 (7%). Students' dropout risk is associated with the faculty ($p=0.068$), where dropout rate is higher among students from the Faculty of Information Technology. The average dropout rate during the 2012-2014 in Faculty of Information Technology was 29.5%. Students with higher school mark are associated with better survival and a male dropout risk is higher than female ($p<0.001$). In this study the factors priority to study in the program and the finance source were not included in the model. Students' dropout at the Latvia University of Agriculture in faculties of

engineering sciences influenced by the factors the competition marks sums ($p<0.001$), gender ($p<0.001$), year ($p<0.001$) and faculty ($p=0.068$) [2].

Keywords: Survival analysis, students' dropout.

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CRANK – NICOLSON METHOD APPLICATION IN PHYSICS

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Crank – Nicolson method was developed by John Crank and Phyllis Nicolson in 1947 (Crank & Nicolson, 1996). It is a finite difference method used for numerically solving the partial differential equations. This method is widely used in physics for solving diffusion (Tadjeran & Meerschaert, 2007; Sweilam, Khader & Mahdy, 2012), heat (Ekolin, 1991) or internal stress equations (Galdikas, Petraitiene & Moskalioviene, 2015). In this article will be represent Crank – Nicolson finite difference method application for solving nitrogen transfer processes in CoCr alloy during plasma nitriding. The kinetics of plasma nitriding of CoCr alloy below temperatures of nitrides formation and mechanisms of nitrogen penetration are analyzed by proposed kinetic modeling. Proposed nitrogen diffusion model is based on the trapping – detrapping (TD) model (Parascandola, Möler, & Williamson, 2000) and developed taking into account the effect of the concentration dependent diffusivity of nitrogen. The model consists diffusion equation, which is a partial differential equation. By fitting of experimental nitrogen depth profiles (Öztürk, Fidan, & Mändl, 2013) it is shown, that nitrogen diffusion coefficient vary with nitrogen concentration according to Einstein-Smoluchowski relation. Nitrogen depth profiles in plasma nitrided medical grade CoCr alloy (ISO 5831 – 12) at T = 400 °C for 2, 6 and 20 hours calculated on the basis of this model are in good agreement with experimental nitrogen profiles. The enhanced nitrogen diffusivity as well as a plateau-type shape of nitrogen depth profile can be explained.

Keywords: Crank – Nicolson method, kinetic modeling, CoCr plasma nitriding.

Conclusion: The model with three main processes 1) trapping – detrapping mechanism, 2) concentration dependent diffusion and 3) swelling process, solved by using Crank – Nicolson finite difference method, explains nitriding process and nitrogen penetration mechanisms in plasma nitrided CoCr alloys.

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APPLICATION OF STATISTICAL METHODS IN THE ANALYSIS OF SENTENCE STRUCTURE

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In recent years, the processes of language computerization have been rapidly developing all over the world and Lithuania as well. The methods used in foreign countries are not always applicable in the Lithuanian language due to its specificity. The Lithuanian language is a complex inflected language distinguishing itself by a variety of grammar forms, morphological ambiguity, grand inflexion, free word order in a sentence, and so on, therefore it cannot use directly the software, already created in other countries, e.g. for automatic analysis of syntax, which causes much trouble in developing efficient algorithms for automatic processing of Lithuanian texts.

Statistical methods are frequently used in the quantitative linguistic analysis (see [1], [3], [4]). The field of linguistics, based on empirical and statistical methods, usually is called a quantitative linguistics. One can single out three methodologies of quantitative linguistics: probabilistic models, statistical linguistics, and computational linguistics. The statistical linguistics is used rarely, the other two methodologies are prevailing.

The computational linguistics, applied in natural language processing, text mining, information retrieval, is based on *n*-grams (usually trigrams) and hidden Markov models and concrete practical problems are solved: automatic textual annotation, language recognition, correction of mistakes, translation, etc. Thus, statistical methods are rarely applied in scientific research of the language itself.

The goal of this research is to explore sentence structures expressed by parts of speech.

Texts that compose the population under consideration are prose books for children (the volume of which is no less than 44 pages) of Lithuanian writers, published in the period 1995–2011.

The sample ('corpus') consists of 720 sentences that were annotated morphologically in a manual way, i.e. the part of speech of each word with the respective properties is pointed out.

Due to a small amount of data, a problem of *sparse* data has arisen, which was solved by recording the annotated sentences and considering a "framework" of a sentence made up from a verb and a noun, which was conditionally called a code.

The code of a sentence is created by changing each word of a sentence by a symbol (letter or number) that *encodes* one or other property of that word as a constituent of the sentence.

Thus, a sentence becomes as if 'a word' whose 'alphabet' consists of symbols encoding the properties analyzed.

The codes of sentence structures of the following types have been constructed:

I – by keeping the order of the annotated sentence, only nouns *D* and verbs *V* are left, and all the other parts of speech are replaced by a symbol "–", several successive symbols "–" following successively are joined; for example, *nnDDnnDVVnDnn* → *–DD–DVV–D–* (here *n* is another part of speech);

Ia – obtained from the code of type I, by joining several successive nouns or verbs; for example, *nnDDnnDVVnDnn* → *–D–DV–D–*;

II – formed just like type I, saving only the information on the case of a noun, i.e. instead of a noun, the case number is written (nominative – 1, genitive – 2, etc.); for example, *nn*11*nn*1*VVn*2*nn* → –11–1*VV*–2–;

IIa – derived from the code of type II, by joining several successive equal symbols; for example, *nn*11*nn*1*VVn*2*nn* → –1–1*V*–2–.

257 sentence codes of type I occur only once, and of type II, regarding the case of noun, even 407 structures are found once (more than a half of all the sentences). In all cases, there are structures met by 30 or even more times.

The Zipf exponent γ in Zipf's law (see [5] and [2]) $f_r = Kr^{-\gamma}$ serves as an index of word diversity. Here $r = 1, 2, \ldots, R$, are the ranks of words arranged in decreasing order of their observed frequencies, f_r is the frequency of words with the rank r, K is a normalizing constant. It is simpler to interpret the law, expressed by this formula, in the log-log scale. For the codes analyzed, the estimators of the Zipf exponent γ, obtained by the least-squares method, are equal to $-1.405, -1.166, -1.457$ and -1.453, respectively.

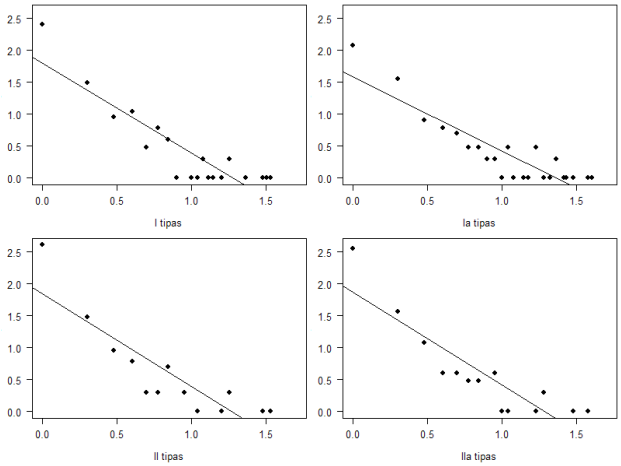

Figure. Log-log graphs of sentence structure code frequency

In Figure, the graphs of sentence structures of types I, Ia, II ir IIa are presented, where $x = \lg r$, $y = \lg f_r$.

Note that the fitted lines describe the data of pairs (r, f_r), in the log-log scale rather well.

Conclusions

If we 'learn' well to identify and analyze (annotate, translate, etc.) sentences of the simplest structure, we can automatically process quite a large part of text sentences.

If we treat structures, that occurred, say, no less than 10 times, as simple structures, we can identify 17.64% of sentences by code II, and even 33.75% of sentences by code I.

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MATHEMATICS IN EDUCATION FOR SUSTAINABILITY: RETHINKING THE CURRICULUM

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Sustainable development, sustainable living requires changes in our daily lives, work and education. Education for Sustainable Development has four major thrusts: promotion and improvement of basic education, reorienting existing education at all levels to address sustainable development, enhancing public awareness and understanding of sustainability, training and skills development for the world of work. (Education…, 2014)
Educating for sustainability seeks to provide knowledge and understanding of the physical, biological, and human world, and involves students making decisions about a range of ethical, social, environmental and economic issues, and acting upon them. (Paige, 2016)
Learning mathematics promotes thinking, problem solving and reasoning skills. It is notable that most mathematics teachers like traditional methods of explanation and the use of rules, formulae; they employ only textbooks, chalkboard and chalk as instructional materials during lectures. Sometimes this results in students' inability to understand mathematical concepts and practice.
The purposeful inclusion of group work and discussion, focus on concepts, authentic problem solving, interactions in lectures with student response systems and online learning are all changing the way mathematics and statistics are taught at tertiary level. (Coupland, 2016)
Traditionally Aleksandras Stulginskis University (ASU) offers agriculture-related study programmes. The secondary-tertiary transition in Mathematics is very problematic for many students. In the article are discussed the new challenges of learning and teaching mathematics.

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IT APPLICATION IN RESEARCH OF DRYING PROCESS

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Drying process is a complex process which research requires participation of experts in different branches. It is necessary to draw in a researcher group experts in food technologies and agriculture, physicist, mathematician and IT experts. Each of experts lends its own input, experience and knowledge of research object, process and ongoing subprocesses, as well as their nature and description in the form of mathematical models and finally implementation in the form of computer model or simulation model. IT progress and integration in educational and research institutions gives considerable contribution and motive for the research field. Their enable to implements and analyse developed mathematical models by different conditions.

The analysis results enable to verify developed models, farther to use them for better understanding of research object or process and make possible to prognosticate the course of process in order of parameter set and initial conditions. Often computer simulations are used like addition to the real experiments in laboratory conditions or its replacement.

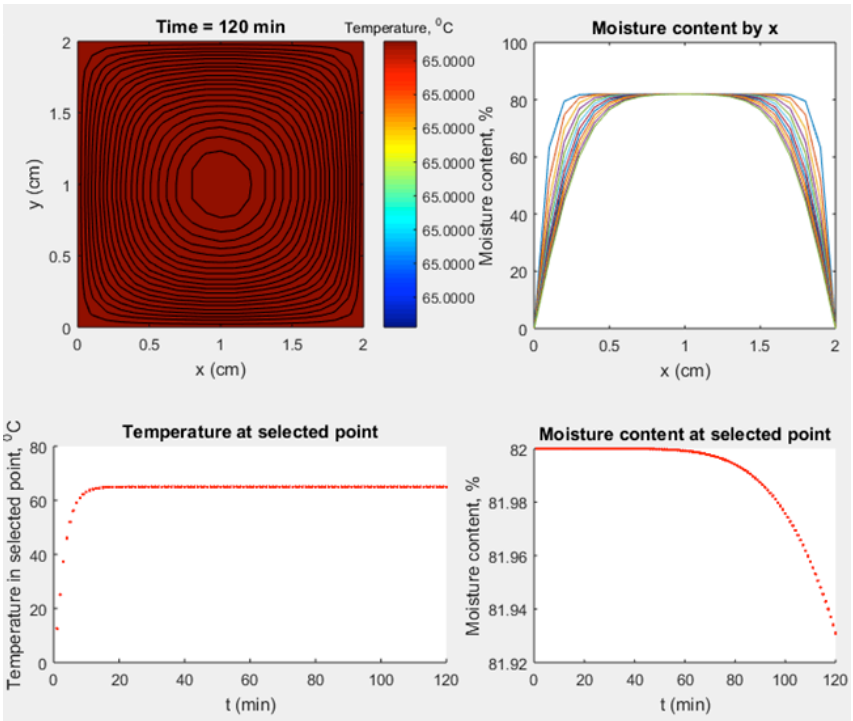

Fig. Computer simulation of moisture concentration changes during drying experiment

Till now many studies were carried out in order to consider and analyse separate aspects of drying process. Part of these studies is related with the modeling of heatmass transfer process [1,2]. Leader researcher of LUA TF Aivars Aboltins in his paper [1] offer the mathematical model of manure drying process where is considered that the manure moisture depends only on the drying time (at constant drying temperature). In this study is considered implementation example of offered mathematical model. Simulation model was developed

within the graduation work under the guidance of this paper author using software tool Matlab. Simulation model enables to watch moisture content changes in potato slices during the drying experiment in the direction of one axis.

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SOLVING SIMPLE ENGINEERING PROBLEMS USING MS EXCEL WITHOUT VBA

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The first year engineering students are struggling to understand the usage of mathematics at university. Using a common program, such as MS Excel (without using direct programming environment VBA), students can see a direct use of data and the results showed in graphs. The usage of MS Excel functions and form control is exploited in order to do simple engineering problem, such as: throwing a projectile or a paper plane to the recycle bin. This problem shows the use of matrices, vectors, system of linear equations and derivatives. Students are able to understand mathematical concepts and engage in learning, when they are shown the practical use of mathematics.

Conclusions

Showing simple models in MS Excel helps students to see why the mathematical concepts – linear algebra, vectors and differential calculus – are important to learn in order to find solutions to the simple engineering problems.

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ANALYSIS OF THE MATH DIAGNOSTIC TESTS' RESULTS

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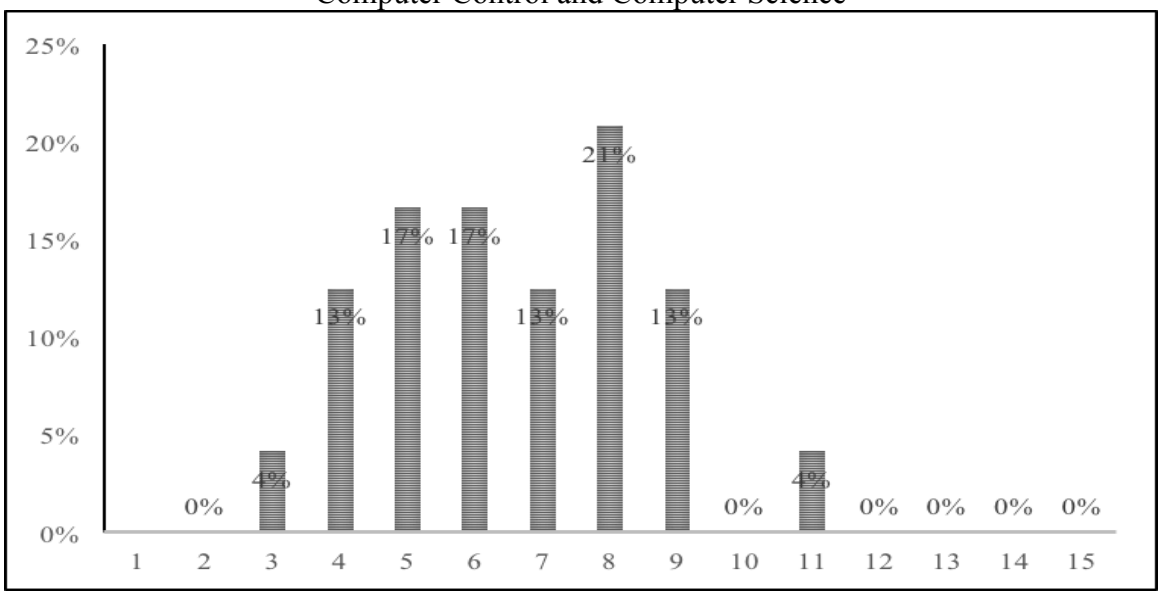
The study process is influenced by several called internal factors including the relevant differences between students (knowledge, skills, competence), different age groups (especially in part time and master's programs), different learning styles, motivation etc. The mentioned factors influence the study programs and determine the achievement of the programme objectives. That's why so called Agricultural Universities in Nordic and Baltic countries have created common diagnostic tests for first year students in order to achieve common standards in mathematics and statistics in common standards in mathematics and statistics in Nordic and Baltic region. The rest of the Nordic-Baltic so called Agricultural Universities have already been using these tests for more than 15 years, but Latvia University of Agriculture at all the university level started only this year. Before they were used only by some teachers.

Several students when finishing the secondary school took both the examination and the test. The findings of the research confirm the already known problem – the previous knowledge of mathematics is low. After analysing tests' results and taking into account teachers experience it can be concluded that the overall competence in mathematics has not increased during the latest years. In 2016 the best results showed the students from Faculty of Information Technologies, specialty "Computer Control and Computer Science" (Table 1).

Table 1.

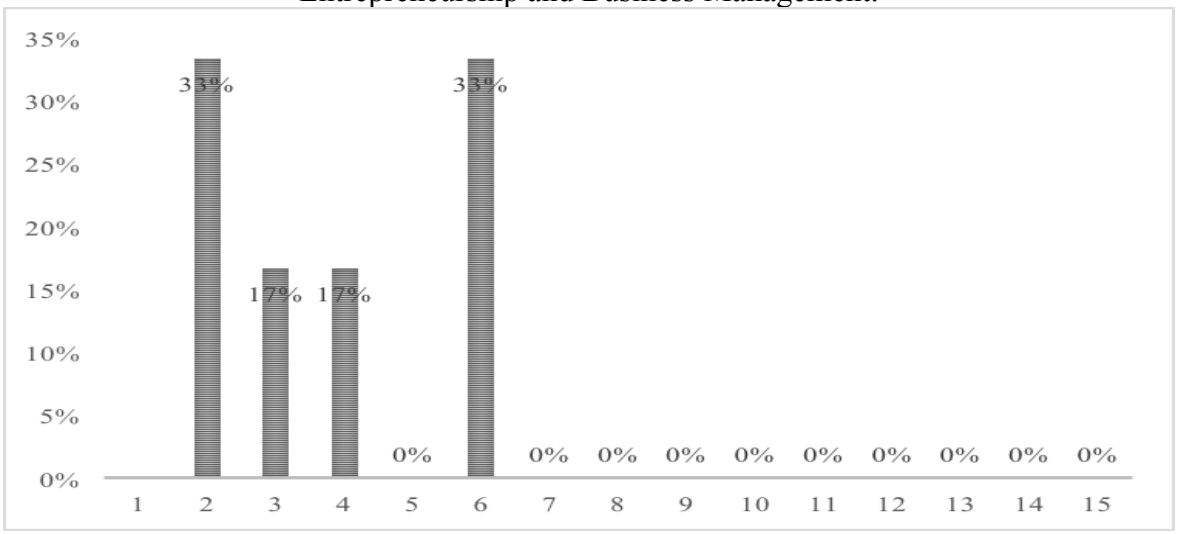
Computer Control and Computer Science



Studies carried out by the teachers of Department of Mathematics, Latvia University of Agriculture show that the lowest results have so-called social block students. For example, in 2016 Entrepreneurship and Business Management specialty students average was only 3.8 points out of 15 possible (Table 2).

Table 2.

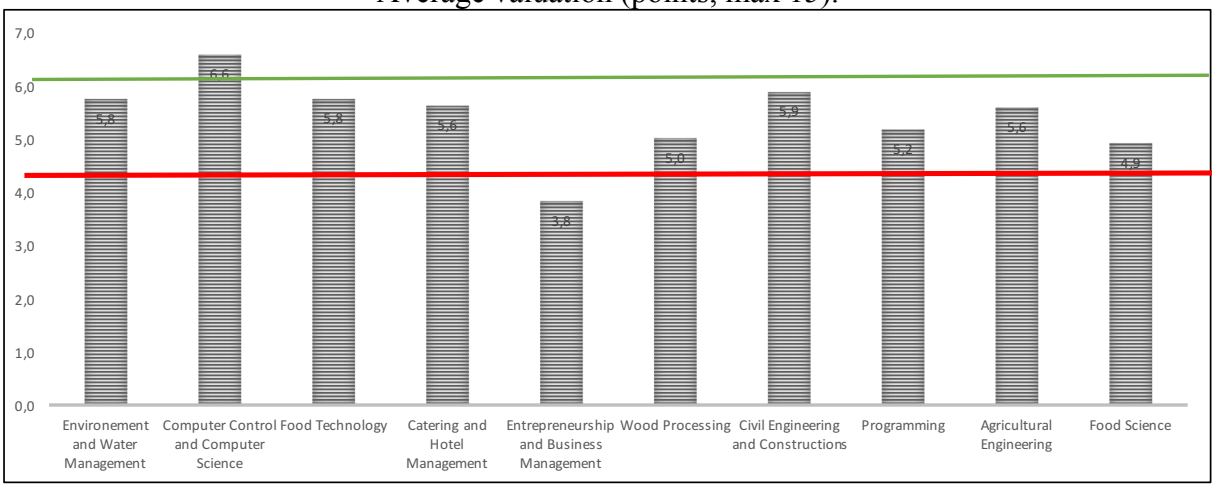
Entrepreneurship and Business Management.



Department of Mathematics for the third time this year organizes the school repetition courses. In previous years, to the courses were invited students whose scores were 7 points and less. In assessing this year's results, it was decided to invite only those who had score 5 or less points. The students' level of knowledge is very low and it is not possible to provide courses for all interested parties (Table 3).

Table 3.

Average valuation (points, max 15).



A relatively low number of students in the secondary schools choose the science subjects because they are quite difficult. That is the reason why so many students of higher educational establishments possess unsatisfactory previous knowledge of science, mathematics, technical thinking, reasoning faculties and world knowledge. Therefore, there is necessity, when providing the students with new theoretical material not only stick to the provision of the important definitions, formulations of theorems and their application but also provide the explanations about the general conceptions that should have been learned in the secondary school. This is a very problematic area because of the lack of actual lectures. When organizing the practical sessions the lecturers have to choose the best and most suitable methods. After analysing the experience of lecturers it can be said that quite often they have to use the method of analogical reasoning faculty based on the process of fundamental thinking of human (in order to remember analogies and later on apply them in the solutions of problematic situations).

USE OF VIRTUAL LEARNING ENVIRONMENT MOODLE IN VARIOUS ASU DISCIPLINES

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University of Aleksandras Stulginskis is broadening its distance education programme in accordance with the strategic goals of Lithuanian education system as well as tasks set by the expansion of Lithuanian distance and e-learning network. Attitude, experience and needs of the students are considered as the most important factors for effective implementation of the distance education programme.

Virtual learning environment Moodle allows to employ modern and up-to-date teaching methods, increase efficiency and quality of the studies. Moodle is becoming more and more valuable in various modules of contemporary universities.

Moodle shows that distance education can indeed be efficient, especially in the cases when the students are motivated, proactive and conscientious. It demonstrates once again that studies and information technology are inseparable in the 21st century.

Students attending ASU continual and extended studies in various faculties have responded positively to the Moodle virtual learning environment and believe it to be an effective incentive for improved learning.

MATH EDUCATION ROLE IN THE SOCIETY SUSTAINABLE DEVELOPMENT

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According to UN General Assembly Report "Our Common Future" Sustainable development is an ongoing, deliberate and logical managed social change process at the world, regional and local level, the aim of which is to provide human needs of the present, without compromising the ability of future generations to meet their own needs. So, the concept of sustainable development is based on the need to optimize the development of economic and social systems, as well as the impact on the environment and resources. The three components are also desirable external preconditions for an individual's development. Therefore, the main task of universities is to provide the new specialists with the necessary education that contribute to each individual's opportunities to acquire knowledge, values and skills needed for participation in decision-making on an individual or collective action at local and global level to improve the quality of life now, without compromising future generations.

Integration of sustainable development into an educational system at all levels is an important challenge that have been encountered in recent years. Universities have a special responsibility to apply their intellectual resources to identify, verify and promote policies, mechanisms and procedures which lead to sustainability in all aspects of human endeavour. This means that the universities have ensure sustaibable development in their curricula, teaching practices, research and consulting, community service activities, institutional practices, promoting the achievement of sustainable futures embracing ecological, economic and social aspects of human existence (Petocz, 2003).

Math at the university in the learning outcomes context has several objectives:

- Individual level (Obtaining a job, mathematics for life, e.g., financial litracy etc.);
- Organizational level (Highly qualified specialists with adequate skills);
- Community level (Math for the scientific and technical community);
- Socio-economic level (Math competences for the socio-economical development) etc.

The study in the context of the sustainable development of society outlines the role of mathematics in three aspects: social, environmental, and economic and mathematics could be seen as approch to life, as a technic or component and mathematics as models (Table 1).

Table 1.

The role of mathematics in three aspects.

SOCIAL	ENVIRONMENTAL	ECONOMIC
Math as approch to life	Math as a technic or component	Math as models
Math provides an understanding of the world and its regularities	*Math is a tool to describe and solve the problems facing society *It provides us with the tools to make informed decisions	*Math provides mathematical models for the help in the planning of resource recovery processes *Models for controlling or reducing the possible consequences

In the conference report, these ideas will be presented more widely to find out the views from colleagues in other countries to determine the directions of further cooperation.

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TEACHING METHODS OF COMPUTER GRAPHICS

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Computer graphics is one of the types of communication in the modern information technology environment. Computer graphics is mostly used in the engineering and architecture because the visual representation in the world of technical information is often the fastest and most efficient mode of information transmission.
The main organization form of computer graphics learning process is practical classes. During the practical classes of the computer graphics the authors use verbal, demonstration and active teaching method. The teacher explains the subject matter with the help of verbal methods, but students when they are listening remember, grasp, perceive and assimilate the new knowledge. The used tools and commands of computer graphics demonstration are multimedia.
Many teachers today want to move past passive learning to active learning, to find better ways of engaging students in the computer graphics learning process. The model below offers a way of conceptualizing the learning process in a way that may assist teachers in identifying meaningful forms of active learning.

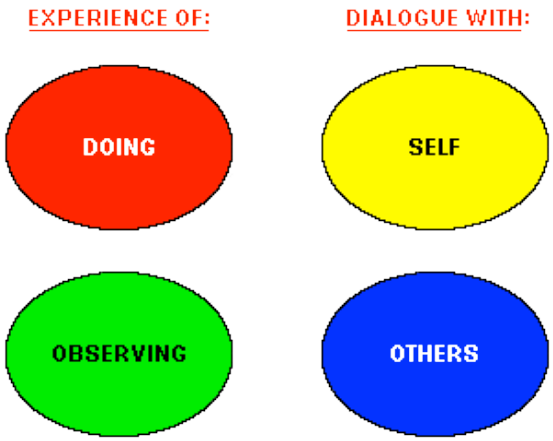

Fig. 1. Active learning model, (Fink, 2003)

This model suggests that all learning activities involve some kind of experience or some kind of dialogue. The two main kinds of dialogue are "Dialogue with Self" and "Dialogue with Others." The two main kinds of experience are "Observing" and "Doing."
Geoff Petty (2009) - author of Britain's best-selling teacher training text, said: "what the learner does is more important than what the teacher does".
Active methods require us to make our own meaning, that is, develop our own conceptualizations of what we are learning. During this process we physically make neural connections in our brain, the process we call learning. Passive methods such as listening do not require us to make these neural connections or conceptualizations. Active methods also give the learner feedback on their incomplete understandings and encourage them fix this, for

example by helping each other; give the teacher feedback on which learners understand, and who needs help; develop thinking skills such as analysis, problem solving, and evaluation; help learners to use their learning in realistic and useful ways, and see its importance and relevance; are more fun; give the teacher a bit of a rest.

N. Semenova (Семенова, 2008) recognizes that in the computer graphics study process active teaching methods have to be used, operating creatively with previously acquired knowledge in a new situation. Špona (2001) considers that notable learning results are obtained only when the student accepts the study course as personally important and will take an active part in it because the teaching and learning processes are mutually connected. Teaching cannot be separated from learning. During the learning process students not only learn but also teach sharing their opinion and knowledge with the teacher and group mates (Freire, 1998). This process is also double-sided in the meaning that students share their knowledge with other students thus contributing into obtaining new knowledge (Fullan, 2003).

Dz. Albrehta (2001) recognizes that the active or discover learning method creates experience to formulate general rules and principles, to identify useful concepts which arouse interest and abilities in students to learn. The teacher's aim is to arrange the environment and comfortable conditions for students' work and development; therefore the needed tools should be prepared to discover that is envisaged to be discovered. Teachers must not allow discovery to happen uncontrolled. Since one can learn something new in a well prepared environment, the learning should be structured in such a way that students would be able to comprehend the material and discover the interesting that they need. Study activities which require discover learning approach motivate students and involves their mind into searching for knowledge necessary to solve problems. Students who make their own cognition activity learn more and better. The more the teachers can succeed in making students to be actively involved in their own learning process, for example combining the new material with the previous knowledge they already have, the more fundamental understanding will be.

The conceptual system of the active learning is connected with a continuity of learning (Bonwell, Eison, 1991) starting with the simplest tasks at the introduction of the computer graphics studies and finishing with the most complicated tasks at the end of the course. During the practical classes by solving tasks students develop their skills in using computer graphics programs appropriate to the aim of the computer graphics study course. The teacher assigns a definite way of solving the given task, organizes the students' cognitive activity by arranging the sequence of the task solving as algorithms and applying the general algorithm for solving the given task. A process of concretization of the general knowledge takes place during the task solving process, the student acquires theoretical knowledge, and skills are formed to be used in practice. Therefore, the more multiform is the task content, the pithier are knowledge and skills. Assignments in computer graphics fulfill multiple functions: actualize knowledge acquired on the bases of the previous knowledge, facilitates skills formation to apply theoretical knowledge into practice. Application of some known components in new tasks of computer graphics strengthen skills, but if you want the tasks become a strengthening means of the skills they must be made according to requirements advanced by I. Podkasijs (Подкасый, 1994) – they are goal-directed, their content is subjected to the goal, exercises are understandable corresponding to the students individual abilities and the real level, and intensity of their repetition facilitates the quality of skills acquisition.

Alongside with the practical classes in the process of computer graphics studies, e-studies are a convenient form how to acquire new knowledge. At the Latvia University of Agriculture, one of the most popular e-study environments in the world Moodle is used, i.e. Modular Object-Oriented Dynamic Learning Environment. In the Moodle e-study environment, figure, video, audio, text material can be presented as well various tasks and tests can be worked out.

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ADVANTAGES AND DISADVANTAGES OF APPLICATIONS OF MATHEMATICS IN PHYSICS

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The study process of mathematics faces two major problems. First, engineers do not apply the problem solving skills of higher mathematics directly. Second, students get an insufficient idea of its usability while studying higher mathematics. This means that it is necessary to include the use of mathematics in the study process.

We can distinguish two large groups of applications of higher mathematics in our life: 1) social issues and 2) physical phenomena. Using higher mathematics, we can solve the social problems such as operations with matrices, finding extreme values, population growth, population crash caused by over-harvesting of natural resources, spread of diseases etc.

More extensive use of higher mathematics is in physics - the science of our nature in which we live. It is known that different nature phenomena happen in time and space, so physical problems can be divided into three major groups of problems (Hung D. Y., Roger A. F. (2002)).:

1) Problems concerning the *motion of objects at a time t***.** For example, motion of objects, the flow of charged particles, Newton's law of cooling etc.
2) Problems concerning the *uneven distribution of the axis (or space)*. For example, the Barometric Formula (p = f(h)), harmonic motion, damped vibration, forced vibration etc.
3) Problems concerning the *uneven distribution of the axis (or space) and at a time.* For example, heat transfer (Q =f (x,y,z,t)), mass transfer (m =f (x,y,z,t)), impulse transfer (k =f (x,y,z,t)) etc.

Showing the use of mathematics in solving the particular task has the following **advantages**:

- students can see the *importance of mathematics* for quantitative description of natural phenomena,
- students learn to *compile mathematical equations* using concrete concepts and relationships (abstract x, y and z is displayed instead of real, concrete terms with physical meaning),
- after mathematical solution of indefinite integrals *constants appear*, which also have their own physical sense,
- students understand the necessity and importance of the *Initial condition.*

At the same time the mathematics teacher, wishing to include the application of mathematics in the mathematics course, faces many problems (**disadvantages**):

- Mathematics is included in the 1st and 2nd year of the curriculum when students know little about their speciality;
- The mathematics teacher as a nonprofessional in a specific subject field should explain technical concepts;
- Technical concepts are taken out of context and therefore they are not well understood by students;
- The number of ECTS in mathematics is reduced and there is no time to solve practical mathematical tasks.

Solution of problem

1) **The interdisciplinary approach** has been defined in 1982 by William H. Newell (Executive Director of the Association for Integrated Studies) as "inquiries which critically

draw upon two or more disciplines and which lead to an integration of disciplinary insights" (Haynes,2002). The interdisciplinary approach is not the same as multidisciplinary approach, which is the teaching of topics from more than one discipline in parallel to the other, and not the same as a cross-disciplinary approach, where one discipline is crossed with the subject matter of another one.

The interdisciplinary approach has many advantages, such as: expanding students' understanding between all disciplines and enhancing communication skills, but it also has disadvantages, such as integration of uncertainties related to two or more subjects of incomplete harmonization and time-consuming curriculum preparation.

Many authors, such as Youngblood D (2007), Duerr, Laura L., (2008) stress that methodology is the key to interdisciplinary success, not the domain of subject material or textbooks alone. Interdisciplinary techniques develop a student's academic skills, promote personal growth and enrich lifelong learning habits.

2) **Including concrete examples in lectures** - in which the teacher explains the mathematical solution method, using specific examples showing how to compile equations and explain what exactly is to be calculated and how and what is obtained.

3) **Organizing the self-directed study of mathematics' practical application**, which is based on didactic approach and e-learning features. *Didactic approach of self-directed study is based on didactic ontology (*Mencke S.,Dumke R., (2007)). As a practical example for self-directed study organization, Moodle computerized learning system (CMS) was chosen, which is one of the main teaching tools at the Latvia University of Agriculture. Moodle has two main tools for problem solution mentioned before – the glossary auto-linking filter and the lesson module. A combination of these tools can improve usability of mathematics in specific subjects and students' knowledge of mathematical operations in their special subjects.

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