DIDACTIC MODEL FOR THE STUDIES OF GEODESY

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Abstract:
The article deals with a brief overview of history of didactic models, the most popular models in Germany and in Latvia, principles and structure of didactic model for studies of geodesy. The didactic models are very different and each of them is based on definite concepts and theories. American, English, German, Russian and local didactic theories are popular in Latvia. A didactic model is a tool for realization of the aims of a teacher or a university reader. In the article, the main parts of the didactic model for geodesy studies are shown schematically: studies methods, aims, tasks and learning settings of the geodesy studies course etc. A reader and a student are conditionally in the centre of the model; forming of professional competence occurs as the result of their constructive cooperation – the studying. The didactic model for geodesy studies is based on cognition and constructivism ideas on processes of teaching and learning. The model includes also assessment of the knowledge and self-assessment of the students on their acquired skills and competences. The studies of geodesy are performed in different settings – in the university setting and in the setting outside the university. The university setting is auditoria and laboratories; the setting outside the university is the Internet setting, city setting, land surveying firms and other specialty related enterprises and departments. Studies results and their necessary competences are assessed according to the descriptions of the Level 6 knowledge, skills and competences of the European Qualifications Framework (EQF). Survey of the students of Land Management specialty confirms efficiency of the developed and approved didactic model.
Key words: studies of geodesy, didactic model, the learning settings, the methods of the studies, competence forming

Introduction

The current situation in the world and also in Latvia requires providing quality of the education in the quickly changing circumstances. Corresponding didactic models have to be selected to achieve it. Professor I. Zogla (2001b) points out that at the university it means not to teach but let study. Learning is not just acquisition of notions and theories, but also social skills and values, as well as forming of the attitude etc. New ideas are introduced continuously, attractive methods are being offered; but Professor I. Zogla (2001c) stresses that Eastern and Western pedagogical ideas are based on different conceptual approaches that sometimes are differing even within the same state. *Didactic model is determined by the paradigm and its basic theory: theory of cognitive, emotional, moral, physical development, socialization, personality theory etc.* (Žogla, 2001d, 28).

Analyzing the basic differences of the study theories, the identification of the basic concept or paradigm of the theory and the didactic models are one of the problems. In daily pace, a teacher or a reader does not have time to identify theories, very much is determined by the quality of the studies programmes, individual features of the pupils, micro setting of the school and the will of the teacher to acknowledge tendencies. All this ensures existence of different didactic models even within a single theory.

Now, there are American, British, German, Russian and local didactic theories applied in Latvia; they all have different essence, although all teaching-learning and studies theories declare themselves being people oriented (Žogla, (2001c, 4). The American theories are based on the philosophy of pragmatism and their main idea is that cognition is individual but teacher finds the right way to teach. The German, the Russian and the Latvian understanding of the studies theories is based on the classical pedagogy where the guiding idea is joining of pupils and their teaching in groups. Also in the Great Britain, alike the USA, the most popular teaching-learning theories are centered towards the students and development of their individuality; interaction between student and teacher is also emphasized.

The didactic model concretizes contents of the pedagogical notions and their interaction: learning, teaching, aims, contents and methods of the studies, etc. To comply with modern university professional education requirements, the didactic model has to provide acquisition of the necessary knowledge and skills and the forming of the professional competence of the students. The model has to be like a learning setting where students are studying independently and in groups, gaining knowledge through cognition (observations, experiments, conversations, etc.), are following their

success (performing self-evaluation, participating in the process of knowledge assessment). This kind of model gives equal opportunities for students of different levels securing individual approach on demand and forms studies links between setting of university and other learning settings outside the university. The above features of the model can be related also to the developed didactic model for geodesy that is analyzed in details in the article.

The aim of the research is to assess promotion of the Professional competence by the developed didactic model for the studies of geodesy to the Land Surveying specialty students of the Latvia University of Agriculture. To achieve the aim, tasks were set as follows: 1) to observe briefly the history of the didactic models, 2) to develop the didactic model for the geodesy studies, 3) to characterise it s elements, 4) to make conclusions on how the developed model benefits to the forming of Professional competence by the results of the student survey based on self-assessment questionnaire. Analysis of scientific pedagogical literature, pedagogical experiment and survey (questioning) are used as the research methods.

At the Latvia University of Agriculture, the studies of the Land Surveying specialty are performed within Land Management professional higher studies programme of the Faculty of Rural Engineering. Within this programme, the study course "Geodesy" has 8 CP scope that compounds about 35% of the amount of all the theoretical part of the geodesy subjects; it is followed by two weeks (2 CP) studies training after the term II. It is approximately one third of the geodesy field subjects; therefore the above study course is of great importance in forming of understanding because the subjects of the following courses are based on it.

To clarify if and how the didactic model for the geodesy studies promotes forming of the Professional competence of the Land Surveying specialty students, the survey was carried out by the questionnaire by the author. There are 25 students questionned after completing their geodesy study practice. They were required to reply to 21 questions regarding competence indicators and criteria. The selection for replies was „yes", „rather yes than no", „rather no than yes" and „no".

Results and Discussion

1. Theoretical aspects of the didactic models

A didactic model is understood as theoretical basis of the pedagogical process, including educating, that helps to plan didactic activities of the school or university (Maslo, 2001,15). H. Gudjons (1998) gives more extended explanation of a didactic model: *a didactic model is a construction of scientific theory of pedagogy that analyses and models generally, e. i., helps to plan didactic processes at a school/a university and outside. A model claims comprehensive theoretical information on preconditions, opportunities and limits of the pedagogical process including studies process. Sometimes these models can be subordinated to a scientific theory* (Gudjons, 1998, 255). As the scientist Gudjons remarks (1998, 256), *studies is too big process to explain it properly by a single didactic model.* The models can be based on a definite paradigm; also mid-paradigm models can be formed. A model is like an intermediary between theory and practice (Žogla, 2001a). Features of a modern didactic model result from the learning aim and tasks; the most important of them are as follows: unity of teaching and learning, unity and comprehensiveness of didactic and education means, solving of comprehensive didactic tasks.

Within the theoretical literature and practice, two types of the models can be observed:

1. *The ones based on a mechanic conception, narrow technological, oriented towards detailed knowledge and neat skills… in this sense, the models of detailed contents are especially "comfortable" in mathematics.*
2. *The holistic ones, based on problem oriented, research, cooperative studies, the contents of the studies is organized in large logical units… Already since the middle of the last century, orientation towards the models of this group has been characteristic in Europe, although some subjects are still considered to be practical and keep previous orientation* (Žogla, 2001a, 135-136).

The choice of the didactic model is one of the most important aspects of productive activity of a pedagogue. J. Babanskis, selecting the didactic model, suggests following the main parameters which involve different factors: studies principles, regularities, aims, tasks, learning abilities of the students, peculiarities of external circumstances and abilities of the teachers. The choice of the model is being carried out taking into consideration all the above structural elements (Babanskij, J. 1985).

Looking back into the history of the didactic models forming, *the basis for the first important model was developed by Volfgang Klafki* (Gudjons 1998, 257) basing on the principles of the critical pedagogy. Nowadays it is well known as *critically constructive didactic model*. The theory of critically constructive didactics by Klafki and the corresponding model are still important and comply with modern scientific pedagogy stances even after the process of several decades (Gudjons, 1998).
V. Jank and H. Meyer (Jank, Meyer, 2002) mark that many didactic theories and models are developed in Germany since the twenties of the last century. As the most important of them, the authors mention as follows:

- Theoretical didactics of the contents of education *(Bildungstheoretische Didaktik);*
- Teaching-learning theoretical didactics *(Lehr-Lerntheoretische Didaktik);*
- the didactics oriented towards tasks/activities *(Aufgabenorientierte-/ handlungsorientierte Didaktik)* un citas.

I. Maslo considering the situation in Latvia writes that, *during recent.. years, development of the didactic theories in Latvia, international cooperation and studies work experience at the schools give opportunity to classify the didactic models: the cognitive, the pragmatic, the communicative, the task oriented and the process oriented didactic models* (Maslo, 2001, 15).
By the analyses of the scientific literature, the features of a modern didactic model can be concluded as follows:

- unity of teaching and learning;
- unity of didactic and education means;
- comprehensiveness, solving of wide range didactic tasks;
- individuality of the studies process;
- methodological and organization flexibility.

It is impossible to adopt any didactic model in its original outfit; just the essential, dominant features and integrity of other didactic models within them could be considered. Any model is more productive at the culture of its origin and straight adoption is not desirable. A tutor has to select or develop the didactic model corresponding the best to his/her concept on a productive didactic process and actual opportunities; besides, the choice of the didactic model is determined by the dominant model of the study programs and the aim of the university – if academic or professional study programmes are carried out.

2.The structure and analysis of the didactic model for the geodesy studies

The didactic model for the studies of geodesy was developed (Fig. 1) basing on the experience of other pedagogues-scientists and on the practice of the author of the article. The model represents the approach that student, teacher and forming of professional competence are in the centre. The studies is a process of constructive cooperation of a teacher and a student therefore there is a mutual link between them. The studies results are one of the elements of professional competence forming. The process of forming of professional competences in the field of geodesy is one of the most important study results, therefore it is of important role within the didactic model. So the developed and proven model can be considered as instrument promoting the forming of professional competences of the further land surveying specialists. As far as the professional competence of the Land Management specialty students is being formed since acquisition of Geodesy in the first studies year, the aim of the developed didactic model is to succeed forming of the professional competence in the above sphere.
The studies of geodesy for the students of the Land Management of the LUA by the didactic model by the author are being performed already since the study year 2008/2009. Development and correction of the model took place during the study years 2008/2009 and 2009/2010 but, in the study year 2010/2011, the approving of the model was performed. Ideally, the didactic model for the geodesy study course has to apply as follows. The didactic model is based on the cognition ideas of the study process (activation and harmonization of perception, comprehension, memorization, understanding and using of information). Within the study process, constructivism ideas are being applied – the knowledge is built by the students and developed through their experience. So the basis of successful learning is active participation of the students in the organizing of the study process and knowledge building. Developing the didactic model for geodesy, the critically constructive didactic model by the German pedagogue V. Klafki was taken as the basis. It says that teaching and learning is the interaction process between a pedagogue and a student. The model is concretized and supplemented

by the ideas of the scientists on learning of the exact subjects and the specifics of the study course "Geodesy".

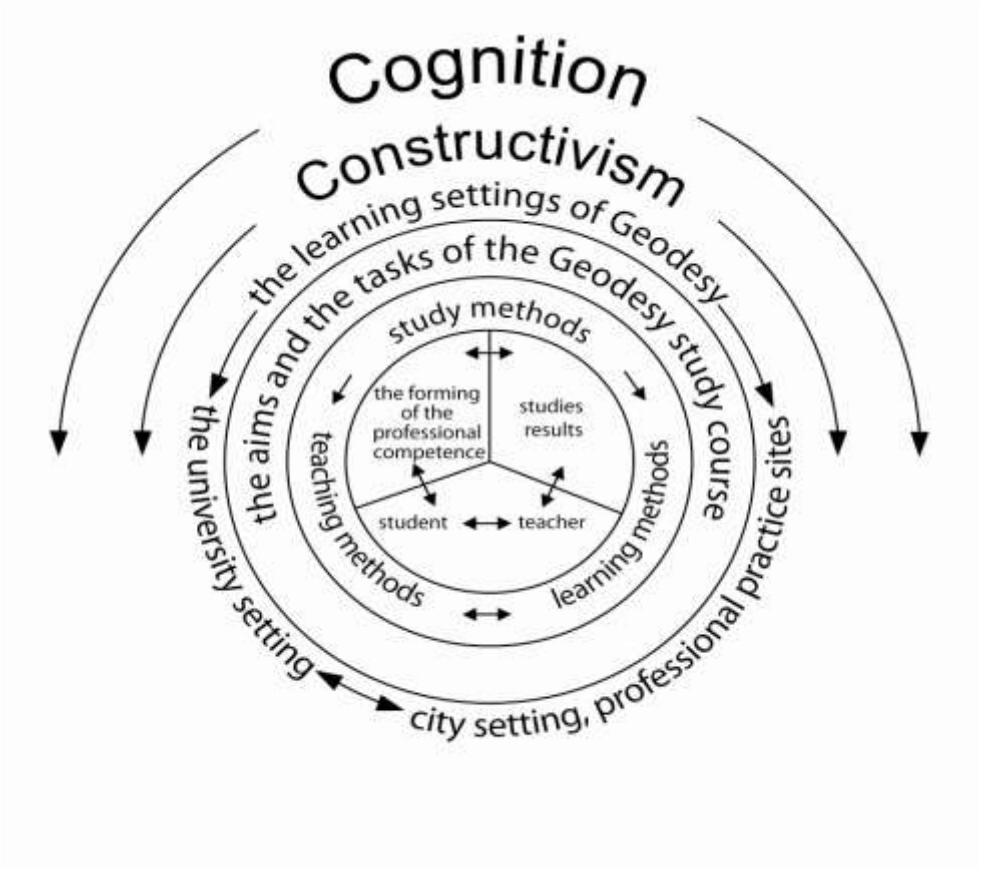

Fig. 1. The didactic model for the study course "Geodesy".

The geodesy studies are performed within the university and also in the setting outside the university. The forming of the professional competence for geodesy takes place both in the contact classes and during study and professional trainings. The study practices in geodesy, in recent years, are organized in the territories owned by the LUA and by the Jelgava municipality. Different learning settings are of great importance in the study process: the Internet setting, municipalities, other specialty related institutions and future employers – surveying firms, the State Land Service and others. The Internet setting as an information source is essential to get ready for the tests and exams and to develop research papers and diploma projects. During the professional practices (trainings), the students have to cooperate with different specialists of municipalities and other establishments and institutions. As far as the trainings take place at surveying firms or other surveying related enterprises, the students meet their officials and managers, thus getting acquainted with their future work places.

The Figure 2 shows links among different learning settings and genetic learning principles because, as mentioned above, the learning settings outside the university are of great importance in forming of knowledge, skills and the professional competence.

In the didactic models for geodesy and other sciences, the contextual approach is of great importance that is directly connected with different study settings. As Professor J. Bruner points out, it is unprofitably to teach specific knowledge without appropriate context of this knowledge because teaching apart of any context makes it difficult for students to incorporate the newly acquired knowledge in the system of the previous knowledge and to see its practical importance (Bruner, 1960). Therefore, study, professional and production practices at surveying firms and enterprises, as well as the Internet in the study process are of great importance in the practical preparation of the students for their specialty.

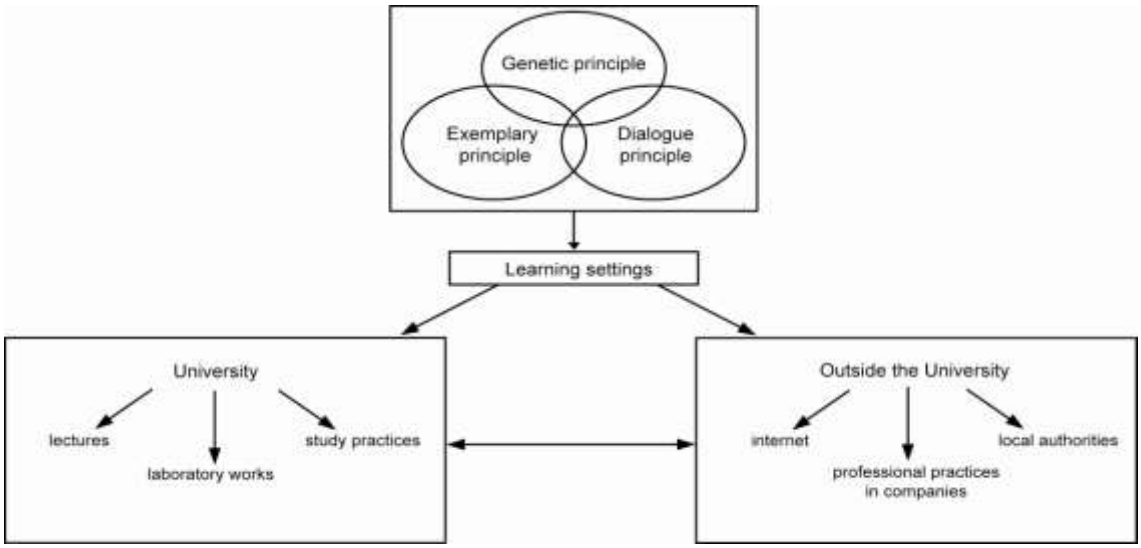

Fig. 2. Genetic learning principles in the course of geodesy in various settings at LUA.

The results of the studies are determined by, firstly, aims and tasks of the geodesy study course that are set in the geodesy study course programme:

1) to get knowledge and practical skills in land surveying, making and using plans, maps and profiles necessary for a land surveyor;
2) to gain the professional and social competences necessary for the job and cooperation.

Studies results and the needed competences are determined also by the European Qualifications Framework – EQF (Noteikumi par Latvijas...., 2008). The 2nd level higher professional education is regulated by the Level 6 EQF with its descriptions of knowledge, skills and competences of the graduates. The studies methods can be divided into teaching methods and learning methods. The teaching methods are based on genitive learning principles, ideas of cognition and constructivism. Record of the theory of the study course of geodesy and sequence of its laboratory works are chosen according to principles of genetic learning and exemplarity. One of several reasons of this choice is that it is too difficult to follow the sequence of the course book of the study course, especially at laboratory works, because of the peculiarities of the class planning. The problem can be solved by the selection of the most characteristic examples. Working with them in depth, students repeat the previous knowledge and learn new skills and patterns. By the principle of exemplarity, the historical relationship of geodesy to other sciences is established. At the University, lectures and laboratory works are conducted in parallel during the study process and it makes it possible to use inductive and deductive teaching and learning methods combined. Within the study of geodesy, the genetic learning with inductive – deductive approach secures the most complete acquisition of knowledge and skills.

The groups of the students are forming as heterogeneous groups. Speaking about learning styles, the study process has to be organized with the students of the corresponding specialty. To clarify the situation within the field, at the beginning of the first year (during one of the first geodesy classes), the students perform diagnostics of their learning style by Kolb tasks (Kolb, 1984). Thus, we get to know belonging of each student to one of the four learning styles. Then the students are informed about their learning style peculiarities. It is conducted by the reader, discussing the plusses and possible minuses of the concrete situation. The teacher considers the results and plans both concrete tasks and the study organization in general. It is desirable also for the reader to do the Kolb task of learning style acknowledgement (Kolb, 1984) and determine his/her teaching/learning style. If it matches with the majority of the students, it can remarkably relief both the teacher's job and the students' studies. But it is compulsory for the reader to take into consideration also the other students, their requirements and learning peculiarities. It means that the reader has to be very flexible and many-sided at studies tasks and teaching methods. At the same time, the students also have to develop their cognitive style to achieve maximum learning efficiency.

Teacher has to use all the available technical study means, surveying tools and other electrical, etc. visual aids. Normally, the theoretical classes of geodesy are organized as lectures and laboratory works; lectures compound about 25% of the total amount of the contact classes. Besides, the students

need also time for the independent work to get ready for tests and exams and to do graphically analytical tasks. The study practice (training) of geodesy takes place after the 1st study year and its scope is 2 CP; it is training time conducted by the teacher. If it is necessary, the students training group works longer period to perform all the training tasks in appropriate quality.
One of the aspects of the model is learning in groups because the personality features reveal working together with others, as well. Several laboratory works and study practices (trainings) are organized this way. The group work study form has its peculiarities and regularities that each reader should know. One of the peculiarities is, for instance, the interaction of the group members that can be positive or negative. The groups for the laboratory works and the study practices are organized by the students themselves on their own choice and intuitively. Therefore, it is possible that students of different learning styles will have to cooperate in these groups. In the group work and geodesy classes, it has positive meaning because the qualitatively total information of problem and task solving appears and several plans and levels are used in their solution.
Success at the studies of geodesy is closely related to the knowledge level of the students at the exact subjects: mathematics, physics and geography. To assess the initial level of the students' knowledge in the above subjects at the beginning of the geodesy studies, the author had prepared a test of mathematics, physics and geography tasks. The results of this test indicate the issues and tasks for more attention in the study process. Mid-term evaluation at each semester is tests on theoretical issues after acquisition of each theme. The tests can involve also analytical tasks related to the theme. The final knowledge assessment is compound of two exams of theory after first and second semester. The results both of the tests and the exams are evaluated by the common 10 balls scale.
Acquisition of the geodesy basics at the university is concluded with the study practice in the summer after the first year. In the end of the study practice, the students group has test assessed with mark by the 10 balls scale. The reader evaluates work of the students during the practice by the precision and quality of the performance of the practical measurements, calculations and the graphical works. During the test, debate is carried out on the work during the practice thus strengthening the understanding of the students. In the assessment process, the students take part, as well.

3.Self-evaluation of the students of forming of their professional competence

After the study practice, the students perform self-evaluation by the questionnaire by the author. Questions are set up regarding the forming of the professional competence in the specialty, factors determining the choice of the profession, how their attitude towards the chosen specialty has changed etc. and it is also required to assess the teaching methods of geodesy and propose their improvement. Figure 3 shows the distribution in percentage of the students' replies per one of the questions: Has the acquisition of the study course *Geodesy* benefitted to your understanding on your carrier in the Land Surveying specialty?

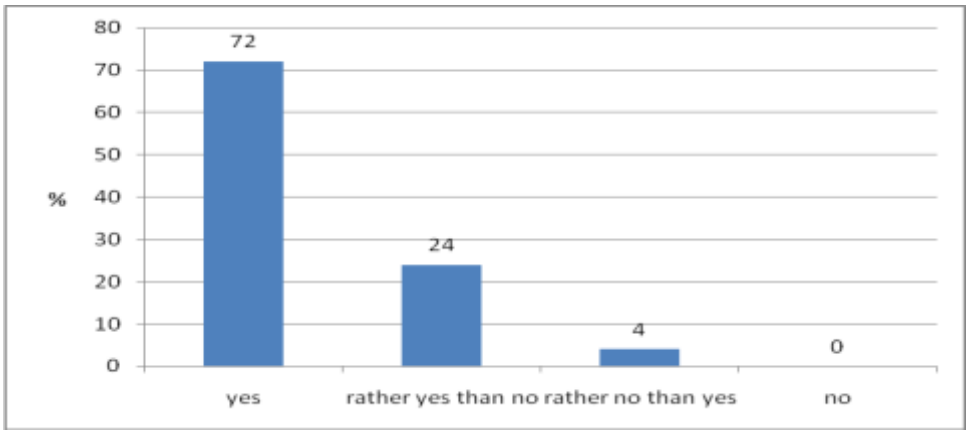

Fig. 3. Distribution (in per cents) of replies by the students of the Land Surveying specialty to the question on their carrier in the specialty.

The results reveal clearly (Fig. 4.) that, by the self-assessment of the students, the studies in geodesy contributes to professional competence, because positive responses are received from 95% - students' answers were "yes" and "rather yes than no " to the 12 questions that derive directly from the competence indicators.

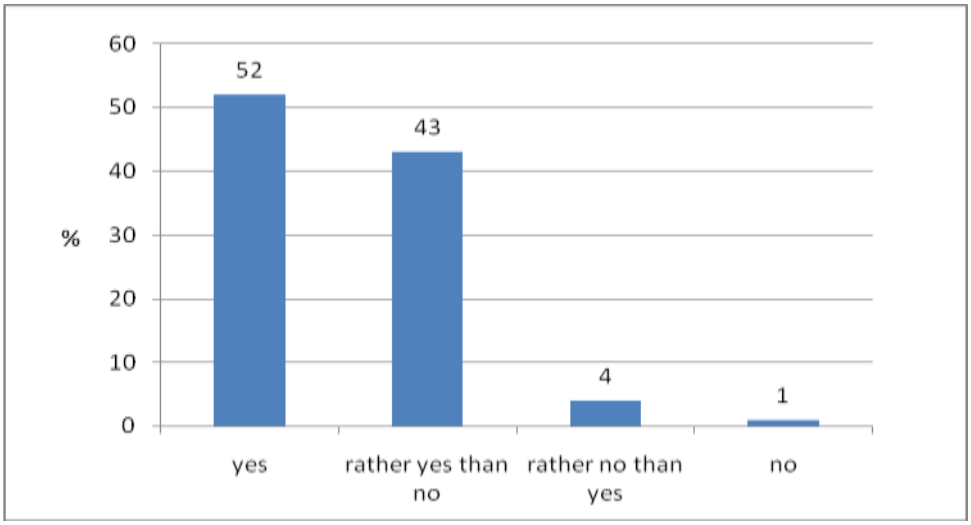

Fig. 4. Distribution (in per cents) of responds of the students to the main indicators of the competence forming.

After the acquisition of the Geodesy study course, the students are ready for further geodesy related subjects in the second year and for the professional practice after the second year. The successfully acquired geodesy basics during the first year are a stabile ground for further forming of professional competence during the studies.

Conclusions and Suggestions

1. By the scientific literature on the didactic theories and their corresponding didactic models, it can be concluded that there is no common approach to this issue by different authors. Different classifications of the didactic models exist. The German didactic theories and models are the most popular in Europe.
2. The didactic model for the studies of geodesy is a mean for achieving possibly better studies results that are precondition for acquiring the essential knowledge, skills and professional competence for the Land Management specialists. The basic elements of the didactic model for geodesy are as follows: setting of study aims and issues, analysis of the initial situation, thematic structuring, using of different didactic means, self-evaluation, control of knowledge and elements of the cognitive models – selection and organization of the study contents, problem solving and experience of independent work.
3. The students survey of the study year 2009/2010 approves that the developed didactic model for the geodesy studies promotes forming of the professional competence. Therefore the author can recommend to use this model for the studies of geodesy and other exact subjects.

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Резюме:
Инесе Бимане. Дидактическая модель обучения геодезии. В данной статье коротко рассмотрена история образования дидактических моделей, самые популярные модели в Германии и в Латвии, а также принципы и структура образования дидактической модели обучения геодезии. Дидактические модели бывают разные, и каждая из них опирается на определенную концепцию и теории. В Латвии распространены американские, английские, немецкие, русские и местные дидактические теории. Из Европейских стран теории дидактических моделей больше всего систематизированы в Германии. Дидактическая модель отражает ход учебного процесса в его динамике, поэтому моделирование и модель являются неотъемлемой частью педагогического инструмента для достижения учебных целей. Они используются как инструмент, с помощью которого учитель или преподаватель ВУЗА реализует свои идеи и цели. В статье схематически показаны главные составные элементы дидактической модели геодезии: методы обучения, цели и задачи учебного курса, учебные среды и др. В центре модели условно находится преподаватель ВУЗА и студент, и в результате их конструктивного сотрудничества, то есть учебного процесса происходит образование профессиональной компетентности.
Дидактическая модель геодезии опирается на заключениях когнитивизма и конструктивизма об учебных процессах. Модель включает оценку знаний, также самооценку студентов о приобретенных навыках, умениях и компетенциях. Изучение геодезии происходит в различных средах: университетской и внеуниверситетской. Университетская среда – это аудитории и лаборатории, а внеуниверситетская среда - интернет, землемерные фирмы, другие предприятия и службы, связанные нужной спецификой. В определении учебных результатов и необходимой компетенции учтены соответствующие описания навыков, умений и компетенций согласно 6 уровня Европейской системы квалификаций (ЕСК) - European Qualifications Framework (EQF). Произведённый опрос студентов по специальности «Землеустройство» подтвердил эффективность составленной и апробированной дидактической модели.
Ключевые слова: обучение геодезии, дидактическая модель, среды обучения, методы обучения, образование компетенций.

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Acknowledgements

Academic study and publication financed by the project „Support for Doctoral Studies Programme of Latvia University of Agriculture" / 2009/0180/1DP/1.1.2.1.2/09/IPIA/VIAA/017/ Agreement Nr. 10-06.1.2/29-ESF.