New Project Learning Environment Integrates Company Based R&D-work and Studying

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Abstract

The need for change has come more and more concrete for the Universities of Applied Sciences' (UAS) in Finland. This need for change comes from different aspects. Companies need more resources and tools to solve their needs for research and development and of course educate students to have good practical skills. On the other hand the staff of UAS's wants to develop and modify the teaching methods. This is why we created AutoMaint Network Factory (AMNF).

AutoMaint research unit has already proven to be very successful of getting real company project from its operating area. Now we try to connect more and more students to company based r&d-work so that students can learn by working in projects. It is as a matter of a fact quite a simple process. We contact the companies in our region and try to find out what are their needs and make projects out of them. And at last, from the three Degree Programmes we have, we find the suitable members of students or staff to start working with the project.

Our future challenges contain the problem of how to inform the contacts we have for business life. Our three Degree Programmes, DP in Business and Administration, DP in Automation and DP Industrial Management, create together a harmony that has every possibility to serve the needs of our regions companies. This new learning environment (AMNF) started in the fall 2008 in the Degree Programme of Industrial Management and about 30 students are studying in it currently. In time, this learning environment will be a part of every Degree Programme of HAMK's Valkeakoski unit.

Introduction

Ministry of Education, Education and Research Development Plan for secondary vocational graduates in the group 25-34 year olds is 45% and it is hoped to further increase by the year 2020. The goal is also that more and more professional graduate's to continue studies at Universities of Applied Sciences. The goal is that 38.5% from the group 24-35 year olds should have completed a polytechnic or university degree by the year 2015 and to the year 2020 the target is 42%. The quality of teaching in Universities of Applied Sciences is to be developed by increasing contacts for working life and by linking work-based R&D more as a part of the teaching. The goal is to develop a student's and work life's relations systematically during the studies.

Universities of Applied Sciences have increased their international degree programmes and the offering English language is extremely wide considering our school system. In the Universities of Applied Sciences internationalization strategy, it is acknowledged that the foreign exchange and degree students, teachers, researchers and other foreign personnel are a resource that supports the internationalization at home base. The international degree programmes of Universities of Applied Sciences goal are multi-cultural study groups, and half the students are from Finland and half foreign. This does not almost ever take place in technical programmes. In international technical degree programmes student groups only a small minority of the students are domestic in practice. In international technical degree programmes should therefore receive more domestic students and more students that are vocational school graduates. International Programmes must also respond to the challenge that foreign students should be integrated more and more to Finnish society and working life. During recession work placements are hard to find for the students', and a particularly the situation is difficult for foreign students. We need to find continuously new ways in which workplace-based R&D activities should be tied into a part of international education programmes.

Description of the working environment

In Universities of Applied Sciences R&D activities and education have to support each other. In HAMK these have been organized into education and research centers. Several degree programmes and already operating R&D centers are integrated for education and research centers. These centers are responsible for the main part of the HAMKs R&D activities.

In the 21st century HAMK has developed engineering education and put effort for new learning environment technologies. In these learning environments HAMK offers the possibilities of physical laboratories and production lines through information network. These are for example remote logins to machines and applications. It has not been the attention to compensate the traditional teaching with this but to use it as a support and a preparing phase. Laboratory and training environments have been developed in HAMK with own resources or by participating into a bigger cooperation projects.

In Finland the Valkeakoski Campus area forms quite unique centre of educational and research institutions. In the same area teaching is provided by HAMK's unit (Industrial service businesses Education and Research Center), professional school, adult education, secondary and industrial schools. In addition to this the campus area has two universities research centers (Tampere University and Tampere University of Technology) and the Development Agency of Valkeakoski region. HAMK's Valkeakoskis units Degree Programmes (International Business, Industrial Management and Automation Engineering) will be conducted in English next fall and this enables new ways to make cooperation between educational institutes. There are total of 2100 students and foreign students fro 30 different countries in the Valkeakoski Campus currently. In HAMKs Valkeakoski unit 25% of the degree students are from foreign countries and the number is to be increased to more than 50% by the year of 2011.

For this kind of new cooperation between different educational institutes Valkeakoski Campus is an excellent piloting environment for many reasons: distance between educational institutes is quite minimal and cooperation between these parties exists concerning education and projects. A good example for educational cooperation could be elementary course in automation for upper secondary school. These practical exercises are implemented with the help of automated miniature model that is representing an industrial property. By doing this the learning experience is more illustrative than the traditional laboratory studies. Modern learning environments have been developed in HAMK and especially in Valkeakoski's Unit. Students can practice real life cases that can be made in these learning environments either by virtually or with miniature models. When the learning is developed for the direction of time and place independent the role for these learning environments will be increased.

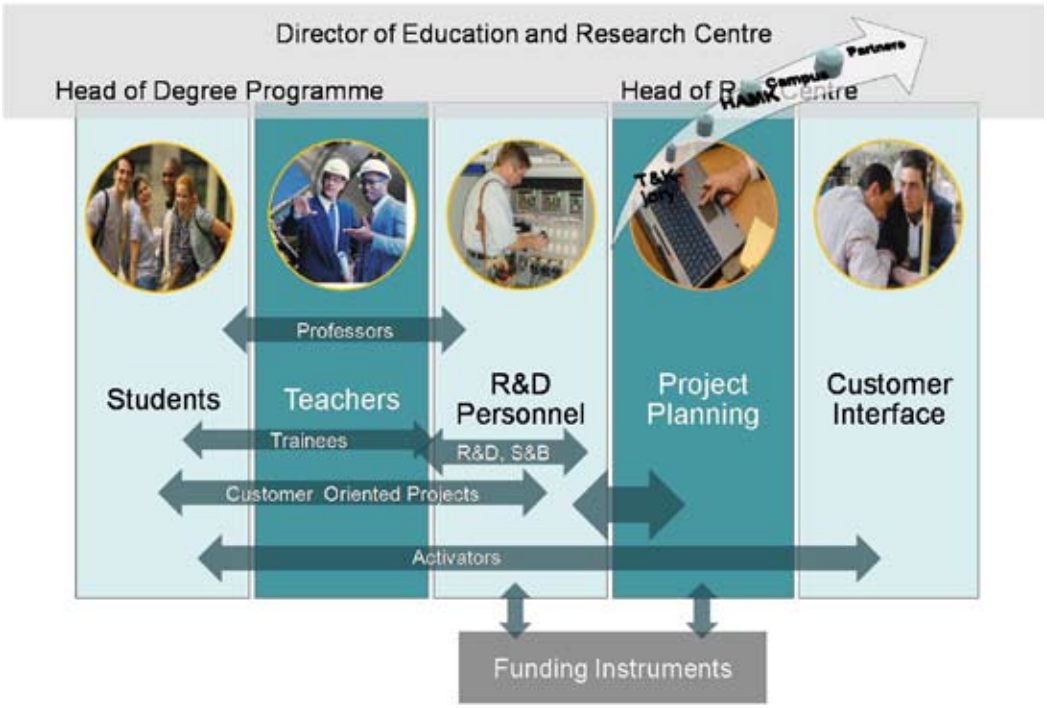
Universities of Applied Sciences R&D work- HAMK's model

For almost ten years in HAMKs Valkeakoski unit companies R&D projects have been made through AutoMaint research and development centre. AutoMaint has grown through the years from small R&D group to R&D centre that employs nearly 30 people now. The objectives have been for AutoMaint to develop the region it operates by offering research and educations services for companies. One objective has been also to develop own education towards real working life so that the graduates skills are in align of future and current company expectations. So by through R&D work we try to influence our region. By networking, national and international cooperation AutoMaint tries to make these more reachable.

In the traditional action researchers and professors were responsible for every step of the projects; they had to find customers, write applications, negotiate with financiers, lead the project and take part in the actual research. A high priority is that the staff spends some time with business people (Lockett, 2008). Very few professors and researchers can do all of those things, and when they do there is a big risk that project will be more university oriented than customer oriented. In our new R&D method employees have different roles. Activators are working in the customer interface trying to find new customer oriented innovation ideas together with companies. Project planners know funding instruments and they are experienced of writing applications. They are also very familiar with the know-how of whole personnel. R&D-personnel take care of research work, but they use, for example, professors as a consultant

or expert when this is needed. Arrangement helps all employee groups to participate in R&D-work and improve learning methods and content of courses (Heikkilä 2008).

Figure 1: HAMKs model of integrating R&D for education.



The operations of AutoMaint are based mostly to the fact that we hire our own students to work alongside their studies. One reason why AutoMaint Network Factory (AMNF) has been created has been the need to reach bigger group of students with projects that increase occupational growth. AMNF has been piloted in the DP of Industrial Management and will be expanded to every DP in HAMKs Valkeakoski unit. This learning environment offers the possibility for students to exploit their skills in real working life cases.

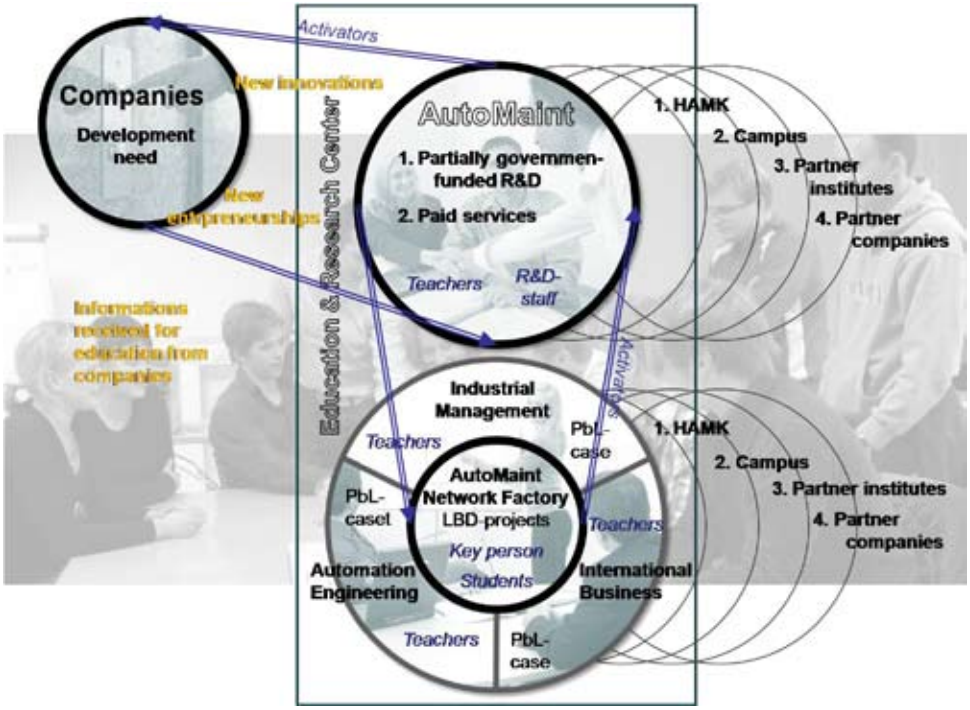
Integrative learning environments as a tool –AMNF

From the students perspective AMNF is a learning environment where to perform studies from technical and business fields by project learning. For the studies made in AMNF there have been reserved enough resources so that students can concentrate to the projects and advance in them. It is also vital that students reach learning objectives set for each course. A key person is coordinating projects and contacts between HAMK and companies in practice. Coordination includes for the project management controlling all projects and organizing teaching when ever it is necessary. The teaching is held by education staff from the unit. Some of the projects contain already students from many culture and different fields of study. This aspect will have a bigger role in the future when all of our HAMKs Valkeakoski degree programmes will be conducted in English.

These processes shown in Figure 2 enable the possibility of cooperation between HAMKs Valkeakoski unit and secondary schools. This gives also the students in the secondary schools to be a part of a whole consisting multicultural and variable projects and participate for the actual work. The process is explained in the following. First AutoMaint research and development centre makes contacts to the company interface. They try to seek new project billets and offer the services from the HAMKs Valkeakoski education & research center. In this phase activators are the key persons. They actively keep in touch with companies' representatives and create new networks. When there is a clear need for the company next phase is to decide what the funding will be. These options you can see on Figure 3. When this is decided it is time to think what the place to suggest the project is. Is it HAMK or some other institute? If it is HAMK then what field is the correct one to make the project? For example is the deadline limited then the creator might be AutoMaint. Some projects are taken straight to AMNF. These projects have few common characteristics.

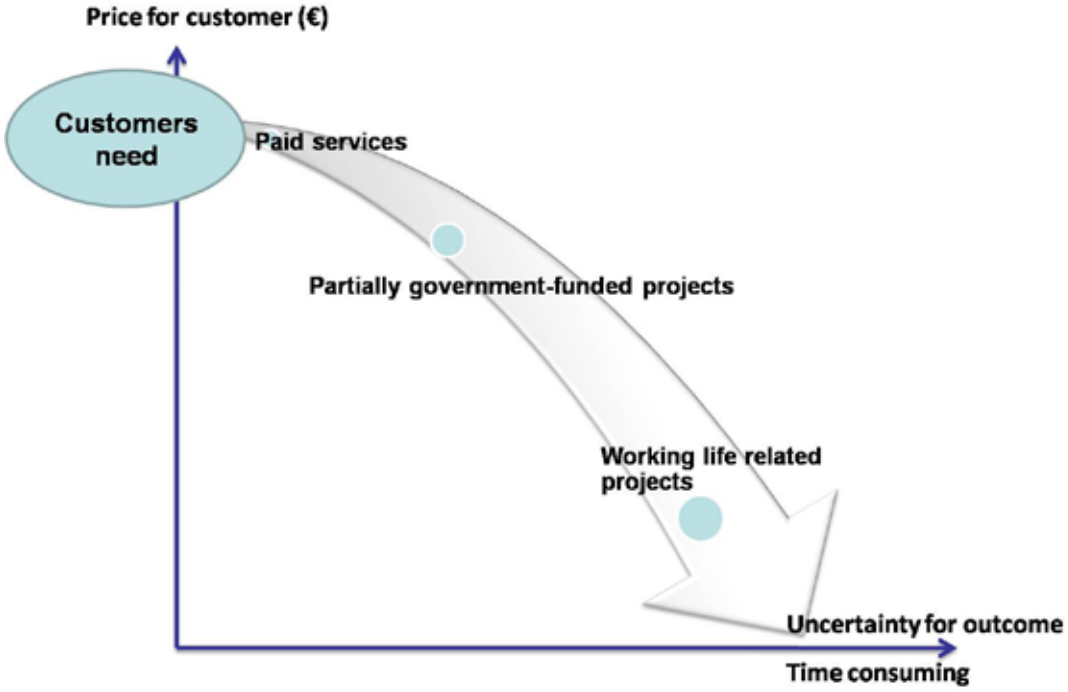
Deadlines are flexible and cost is somewhat reduced. Companies can provide guidance and give assessment for the project group. Uncertainty for the outcome is bigger but when used correctly AMNF can also be used as a recruiting channel.

Figure 2: AutoMaint Network Factory's model for operations.



As can be seen from Figure 2 the whole process has many levels. AMNF tries to make as much as possible cooperation between other institutes in Valkeakoski but also with many other for example Tampere University. The model for this process has been developed through year to in the form it is now.

Figure 3: Relations between projects and funding.



On Figure 3 you can see the possibilities for a company to make a choice for projects funding. It is always depended

on projects scale, field of research, companies own financial standings and in which department this projects could be done. Projects made totally by students cost less than project ordered from AutoMaint but also deadline and uncertainty increases.

Learning environments benefit for students, companies, teachers and operating area

The benefits for this kind of learning environments are quite extensive. Students receive authentic experiences by participating projects and have the possibility to create their own networks. Many students in present day are also working alongside studies. This learning environment gives flexibility to studies and combining studies and work is a lot easier. Of course this does not mean that there is less work. It means students are expected to be more self-controlling. Arrangement means more independent learning, more interdisciplinary and multidisciplinary studies and increasing need of creativity and innovation and more working in multicultural teams. All if those things have a very important role in future trends in engineering education (Rosen, 2007). The staff is in this model more trainers than traditional teachers. The staff can be a part of challenging projects and act as experts in them. The staff is working also as a filter taking right projects for the learning environment. This means that the projects should have a clear connection for the studies that are tied for the learning environment.

Companies have two most obvious reasons why do R&D projects with AMNF. The first benefit is that the learning environment if fairly cheap way to do R&D work. Of course there are some risks that have come forward earlier in the text. The other reason is that this can and should be used as a recruiting channel and it is a quite safe way to find out if the person is suitable for the company at question.

Future development of learning environment

Many companies are in the economical situation now that they just have no possibility to participate in a learning environment like AutoMaint Network Factory. AutoMaint Network Factory needs to be seen and known in the companies and this is a message AutoMaint research and development centre will take too the companies (Ylitalo, 2009). The companies participating are quite small and have either no knowledge or resources to make these kinds of development projects. The companies want to develop maybe with smaller input in money than they would in other ways. They expect good quality work but also give students time and guiding for the project. Challenges appeared now have been concerning scheduling, motivation and finding right kind of projects to the learning environment. The schedules in the beginning were planned with too short time periods and linking teaching to studies was challenging. The development in this means that staff plans next semester's resources, classes and projects in some amount. In motivation the problem has occurred during the first pilot semester from time to time.

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PERFECTION OF TRAINING BY "ENGINEERING AND COMPUTER GRAPHICS" AS A PLEDGE OF STUDENTS INVOLVEMENT IN RESEARCH WORK

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Abstract

Paper devoted to issue of perfection of training by "Engineering and Computer Graphics" as a pledge of students involvement in research work.
The concept of «Descriptive geometry, the Engineering and Computer Graphics» teaching under conditions of physical and mathematical training intensification necessity have been considered.

Modern manufacture requires highly skilled engineers and designers (constructors) so requirements to graduates of corresponding higher education institutions constantly increase. The Minister of Education and Science of Ukraine professor I.Vakarchuk at meeting «Modern physical and mathematical science and education: tendencies and prospects» on October, 30th, 2008, noticed that for experts of a technical profile physical and mathematical sciences are essential part of high school training. It is proved that while studying these disciplines the future expert acquires not only methodological, but also the psycho-physiological base of systematic, logic and critical thinking which is extremely important for future performance.

In this connection specific weight of such mathematical subjects as descriptive and analytical geometry increases, as far as they make grounds for spatial thinking of the future expert – in other words, drawing and descriptive geometry at the present stage should be treated as computer-mathematical disciplines, rather than as purely graphic disciplines. It is necessary to consider that geometrical training as the component of general mathematical training is a basis for geometrical modeling and computer design. To be competitive on a labor market the modern engineers should not only have thorough special knowledge in their field, but also possess the whole set of skills connected with computer designing, practical use of computer systems of engineering graphics. Nowadays requirement – being able to perform all kinds of project and design works using modern computer facilities, create the design related and technological documentation and presenting it on corresponding magnetic carriers in the mathematical models and computer programs recognized at world level.

One of the causes of difficult situation in the higher school at the moment is on the one hand reduction of learning hours to study geometry and the engineering graphics, especially considering absence of corresponding training at secondary schools; on the other hand – absence of basic knowledge among first-year students on such classical engineering disciplines as drawing and descriptive geometry. Thus almost one third of school graduates do not know basics of geometry, geometrical constructions not only in space, but even on a plane. It is confirmed by results of entry level test conducted by department throughout last five years – we see the further decrease in basic knowledge in geometry among first-year students.

Reasons stated above raise the complexity and urgency of problems which are to be solved by teachers of the former department of descriptive geometry and drawing, and now – department of engineering and computer graphics and bases of computer design where students are trained in methods of creating mathematical models of various geo-

metrical images.

Solving such problems requires the serious methodical work, constant updating of the primary goals and course tasks, increasing (renewal) amount of learning hours for in-class studies, checking of graphic works, assigning current and total tests.

The primary goal of «Descriptive geometry, the engineering and computer graphics» course – is acquiring knowledge, developing skills and abilities of the future expert (the engineer, the constructor) in the field of new technical elements design. For this purpose it is necessary to develop their spatial imagination, logic and to give basic training to present spatial objects on a plane (drawing), and solve positional and metric tasks on this drawing. As it is known, the drawing is language of technics, and descriptive geometry – grammar of this language.

Specificity of disciplines "Descriptive Geometry", "The Engineering Graphics", "The Computer Graphics" consists in acquisition not only certain amount of theoretical (declarative) knowledge, but also developing skills and abilities of reading and creating the drawing, constructing the details. To get such skills and abilities during the course of training is possible only by performing calculation and graphic assignments. To check up quality of performing these works, to give appropriate feedback and specify errors made by student, to teach how to use reference books – are the primary goals of the departmental teacher – it is the groundings for further learning majority of technical disciplines.

In the conditions of the further implementing and improvement of Bologna Process particularly in assessing students' performance by means of testing, this important point (performance and check of drawings) has no corresponding reproduction in the planned methods of quality monitoring. Carrying out tests allows to assess only declarative knowledge of students, but does not give possibility to check, whether they have acquired main principles, logic and algorithms of the problem-solving, or can apply requirements of standards, etc. It can be checked only while performing corresponding graphic works.

Results of remaining knowledge control showed that in half a year the quality indicator of knowledge decreases almost to half. In our opinion it is caused by following disadvantages in organization of educational process:

• The general reduction of learning hours on discipline studying;
• Cancellation of the final control (examination) and its replacement by assessment on separate modules. For the final control (examination) the student usually repeats the whole material, has possibility to rethink it, to establish connections between separate parts (themes) of discipline which are given by possibility, to better comprehend and remember main concepts and methods of the problem solving;
• Besides, it is necessary to notice that the part of workloading part is transferred to graduating departments as some special courses. At the same time mastering of special courses is usually not so effective due to absence of basic knowledge. Such reduction of learning hours is one of factors decreasing the quality of education.

However it is necessary to keep in mind that in spite of all doubtless utility, automatization of engineering work in educational tasks not always leads to improvement of actual engineering training quality. Students sometimes do not receive enough of even that knowledge of technical objects properties which was given by traditional pre-computer training. Besides relative easiness in receiving results using computer reduces the motivation and interest in the result. Purposeful search and error training in finding the optimal or rational decision in design tasks is much more interesting and instructive for the future engineer, than receiving only one optimal design which cannot be improved and could not be compared.

Hidden calculation processes provided by computers also disserve engineering training purposes. Many calculations which we quite often declared to be routine work, have a strong training effect as far as they allow to track and understand connections of technical object's variables values and its characteristics. This particular circumstance also

is in some cases the reason of the cautious attitude of engineering teachers towards using computers in educational process. Skilled engineers think it can be a problem with computerization of training – it can negatively affect development of such important engineering qualities, as intuition, constructing thinking, ability to perform deep analysis of technical objects and processes properties. Traditional training techniques aimed at the development of these engineering qualities, based on educational calculations and design without using computers, due to lack of intensity and little prestige, do not meet current requirements any more.

Summarizing the issues discussed above, it is possible to draw a conclusion that, along with the future engineers' mastering new information technology, and training computerization it is necessary not only to keep, but also to strengthen traditional engineering training using computers in the certain subject domain, based on professional intuition, knowledge and understanding of fundamental physical principles of technical objects and processes construction and functioning. It is obvious that in solving the problem the important role belongs to the computer graphics. It is no coincidence in saying that the engineer thinks with images. The exclusion of classical sections of engineering training in particular, "Descriptive geometry" from curricula is unacceptable.

To improve educational process department of Engineering and Computer Graphics suggests following.

1. It is necessary to reconsider learning curricula and renew the status of an engineering and computer graphics considering both structurally-logic schemes, and amount of learning hours for this discipline in the block of standard disciplines. It is reasonable to increase amount of learning hours to teach both basic categories of descriptive geometry and engineering graphics (displaying methods, classification and drawing curves and surfaces in space and on projections, profound studying of standards of ESKD), and modern methods of computer design. At the same moment it is necessary to provide a continuous training in graphics for future experts.

2. To establish necessary quantity of calculation and graphic assignments – one for each module. In the curricula of the discipline 3 modules in section "descriptive geometry", 3 modules in section «engineering graphics» and 2 modules in section «the computer graphics» are planned. For each module the amount of learning hours should be planned (according to corresponding normative 0,5 hours for 1 assignment) for checking, explanation of made errors and defending the works. Exclusion graphic assignments from curricula will lead to losing practice supply for tasks, it will also emasculate the discipline, will reduce it to tests and guessing the right answers. The control of each module mastering should consist of declarative knowledge tests (40 % of estimation) and assessing procedural knowledge and practical skills in performing drawings by traditional means or using computer graphics software.
Besides, the offered norms for learning hours spent on module control is significantly lower than the ones planned for pre-examination tutorials and exams. And unlike for the majority of other disciplines this control provides graphic tasks performance.

3. Teachers should not be oriented only on making students to memorize certain abstract algorithms, but also should organize and facilitate self-directed search, conducted by students. One of opportunities for such work should can be students' work on some design problem in small groups where they conduct the analysis and work out of the defined construction.

4. It is reasonable to increase amount of learning hours to study basics of geometrical modeling and computer graphics at mechanical and road-building departments, at least up to 36 hours along with maintaining continuous training (for example, with means of university elective disciplines).

5. Besides, it is desirable to find hours for teaching a profound special course on «Computer methods of parametrical modeling and design» for the future Master students. Essential result of fundamental training in graphics is stage-by-stage forming the students' ability to implement fundamental mathematic and geometric knowledge and skills of geometrical modeling using computer and perform course, degree projects and scientific researches.

6. To increase and order the level of knowledge for entrants and first year students, adaptation course for secondary school program in graphics should be implemented and developed.

Project-based learning shares the aspect of students working on problems in teams, but with the added component that they have to submit a project report completed collaboratively by the project team. The problem- and project-based/project organized model adopted at Aalborg University and Roskilde University, Denmark, was inspired by the critical pedagogy in Europe after the student revolts of the 1960s.Â New approaches to problem-based learning â€“ Revitalising your practise in higher education. New York, NY: Routledge/Taylor & Francis. Barrows, H. S. (1996).Â Paper presented at the Invited Symposium on Web-based Learning Environments to Support Learning at a Distance: Design and Evaluation, Asilomar, Pacific Grove, CA.