# METHODS TO IMPROVE THE QUALITY OF DESIGN CAD TEACHING FOR TECHNICAL SPECIALIST

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## Abstract

Digital literacy is a necessary skill for a modern specialist and an important factor influencing the development of the economy in all industries. Automation of technological processes requires an appropriate level of training of specialists, among the necessary skills of which should be knowledge of a CAD program.
In order to improve the level of education and competitiveness of specialists (including those who have temporarily lost their jobs), Tallinn University of Applied Sciences (TTK UAS, Estonia), in cooperation with the Estonian Unemployment Insurance Fund, has been organizing and conducting training on the use of CAD programs since 2012, including CAD design with AutoCAD, both 2D and 3D, as the most universal CAD program. To ensure more effective training, teachers of advanced training courses, who are the authors of the article, constantly monitor the labour market to determine the requirements for technical specialists. In accordance with changes not only in the requirements for the level of training of specialists but also taking into account constantly developing technologies, the training program is also changing. Recently, in connection with the pandemic, it has become necessary to conduct not only face-to-face training but also online, hybrid, which required not only updating the educational material but also a new approach - the use of interactive tools in training.
Since 2021, TTK UAS conducts in-service training for adults including CAD design with AutoCAD within the framework of the Ministry of Education and Research's state training order for in-service training “Promotion of adult education and broadening of learning opportunities”, for learners is free of charge.
This article analyzes the statistics and demonstrates the use of this analysis to assess the necessary changes in the curriculum to improve the effectiveness of the study of the CAD program.

***Keywords:*** *Lifelong learning, CAD design, distance learning, interactive education.*

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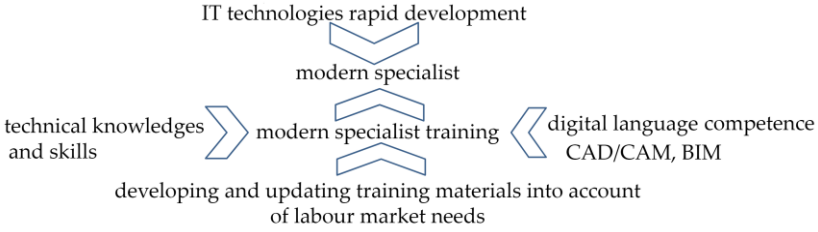
## 1. Introduction

High demands are placed on a modern specialist - professional solution of current problems, successful participation at all stages of product development. The rapid development of IT technologies is reflected in the work of production, updating equipment, which requires specialists to work. Successful implementation of these technologies requires extensive use of 3D geometric models. Engineering courses should deal with the development of spatial imagination and 3D models using CAD tools. Universities should be more actively involved in the process of faster implementation of these technologies. The general background knowledge needed to solve this problem is the development of spatial visualization skills, since both of these concepts are based on a three-dimensional (3D) geometric model or database (Dobelis, 2019). Involving a learner in an active educational process to gain new knowledge is a priority to ensure the effectiveness of independent distance learning, educating an independent and modern specialist who is able to solve complex production problems and be guided by the priorities of society (Figure 1).

*Figure 1. Educational tasks of a technical specialist.*



To improve the qualifications of a specialist, not only the appropriate training of teaching staff is needed, but also modern interactive educational materials for self-work of learner and mostly online or e-learning.

Electronic learning, or e-learning, is education based on modern methods of communication including the computer and its networks, various audio-visual materials, search engines, electronic libraries, and websites, whether accomplished in the classroom or at a distance (Showkeen, 2015).

Students learn more when they see objects in reality. Creating 3D virtual reality (VR) models and immersing students in that virtual reality can provide an engaging and meaningful experience (Salman, 2020).

Educational institutions will benefit from better accessibility to virtual technologies; this will make it possible to teach in virtual environments that are impossible to visualize in physical classrooms, like accessing virtual laboratories, visualizing machines, industrial plants, or even medical scenarios. The huge possibilities of accessible virtual technologies make it possible to break the boundaries of formal education (Martín-Gutiérrez, 2017).

## 2. Objectives

Educational institutions will benefit from better accessibility to virtual technologies; this will make it possible to teach in virtual environments that are impossible to visualize in physical classrooms, like accessing virtual laboratories, visualizing machines, industrial plants, or even medical scenarios. The huge possibilities of accessible virtual technologies make it possible to break the boundaries of formal education (Martín-Gutiérrez, 2017).

The Estonian Unemployment Insurance Fund has sufficient financial reserves to start offering services aimed at preventing unemployment and helping small businesses. These services are for employees who need support to change jobs or keep a job due to lack of skills or their outdated skills, as well as employers to help them find and train a skilled workforce and restructure their companies.

From 2019 to the present day, a program to help businesses in conditions of increased risk of infection and Covid disease has been operating in Estonia.

The Department of Academic Affairs and the Science Center of the TTK UAS, in cooperation with the Estonian Unemployment Insurance Fund, conduct training courses to improve the qualifications of company employees and acquire digital skills and computer skills.

Based on training courses conducted using various CAD programs, TTK UAS developed a new training course using Autodesk AutoCAD as the most versatile CAD program (Ovtšarenko, 2021).

In the period 2017 - 2022, The Department of Academic Affairs of the TTC UAS and the Center for Sciences conducted 7 training courses (30, 64, 120 hours long) on teaching AutoCAD (including 2D and 3D). There were a total of 74 participants in the courses, and a maximum of 18 students per course.

Since 2017, a very different level of computer proficiency among students has led to a radical change in the curriculum, the creation of multi-level tasks for students to choose feasible tasks and the creation of video lessons for independent work. Since the beginning of 2020, the pandemic has affected all aspects of education and course teachers - the authors of this publication have developed teaching materials for conducting online courses.

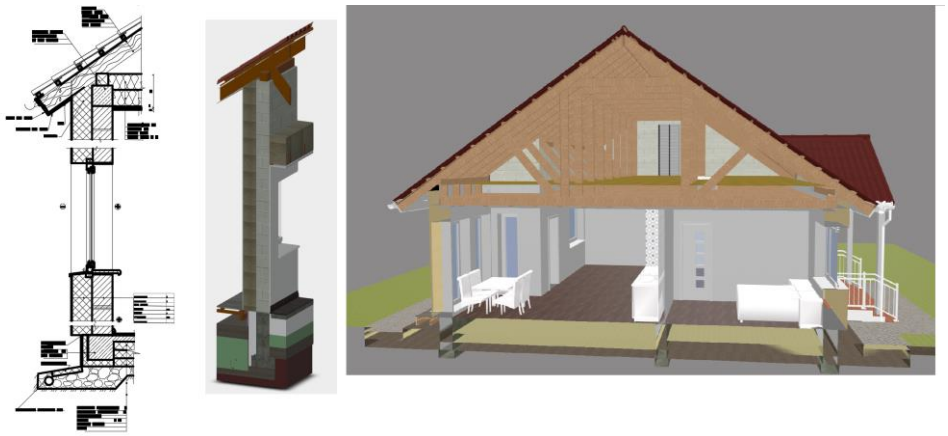
All training materials are posted on the e-course website and are divided into modules. Each module consists of a theoretical part - linked individual websites, short step-by-step instructions for practical exercises, exercises for online work both with the participation of the teacher and independently, and forums for group and homework. Some course participants dropped out of the course, mainly due to the busy schedule of the course and poor computer proficiency. Most of the participants, after completing the course, indicated during the survey that they can successfully use the knowledge gained at the training in their daily work and independently find and use the necessary information to develop the acquired skills.

The results of the conducted surveys and the analysis of current changes in the requirements for specialists in the labour market made it possible to obtain information for making significant changes in the content of the training material of the courses and to test it during the courses. In the period 2017-2022, the authors of the article created video tutorials to support and gain more stable skills in working with the program. Also, in addition to practical training material and exercises on creating drawings, theoretical material was compiled based on a review of the standards and rules for creating drawings, and the basics of engineering graphics, which is necessary for competent and successful work in an enterprise, for transmitting and processing information using technical drawings.

The surveys of additional training participants showed qualitative changes in the acquisition of skills in working with the AutoCAD program, as students in a fairly short period of time learned to understand drawing images, annotations and dimensions well.

The effectiveness of the educational material on the basics of engineering graphics was also achieved through the use of simulation of 3D objects (Figure 2), which are very effective when it is impossible to demonstrate or visit real objects depicted in the drawings as the cross-disciplinary collaboration (Pulido-Arcas, 2021), and provide a very interesting opportunity for a student to immerse himself in the study of engineering or technology (Makuteniene, 2020).

*Figure 2. The integration of BIM into the subject of basic engineering graphics. Wall part of the house and the house digimodel.*



## 3. Conclusions

The Estonian state program not only takes care of retraining and additional training of employees of enterprises, but also includes a plan for retraining people with partial disability. Employers are very interested in employees who work and only replenish existing knowledge and skills but do not need to study from beginning.

It turned out to be necessary for the successful implementation of the training to monitor the needs of the labour market just before the starting of the training program and the development or updating of exercises for work in class and homework. It is this tracking of changes in the need for certain skills and abilities that is the key to the successful work of both course teachers and the study work of course participants.

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