# INTEGRATING MULTIMEDIA INTO TEACHING A TECHNICAL DRAWING COURSE

**Renata A. Górska**

Cracow University of Technology (CUT)
Division of Descriptive Geometry, Technical Drawing & Engineering Graphics, A-43
Warszawska st. 24, 31-155 Kraków, Poland
email: rgorska@pk.edu.pl

**Abstract.** This paper considers the possibilities of integrating modern teaching tools into traditional technical drawing courses.

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## 1      Introduction

Didactics of such courses as **Technical Drawing (TD)**, **Engineering Graphics (EG)** or **Computer Aided Design (CAD)** which belong to the group of professional subjects in the first year of engineering studies (which is equivalent to a freshmen level of the American undergraduate program) at all technical universities in Poland includes not only teaching the principles and the standards of designations used in technical and construction drawings but also incorporates the elements of any CAD system, which in most cases occurs to be AutoCAD software [1]. The course is a 2 European Credit System (ECTS) course; while a full academic year corresponds to 60 ECTS. Each student in his/her 1$^{st}$ year of studies faces difficulty of such situation where he/she neither knows the basics of engineering design nor is able to work in the AutoCAD environment. Blended-learning systems, which are present at our universities today, help our students become more flexible and take advantage of the information delivery through the Internet website for the relevant courses. The students can study and get experience through the Internet connection today. The Moodle system (Modular Object-Oriented Dynamic Learning Environment) has been implemented at Cracow University of Technology to support e-learning for 3 years. It is one of the most popular open-source systems used at universities, which is available free of charge in frame of the GNU GPL license [2]. Although the system is highly challenging for the authors - regarding the time and effort which must be put into a design process and to construct a specific course - the outcome is beneficial to the students in the form of an extra source of knowledge delivery.

The goal of this work is to present the **Technical Drawing (TD)** course addressed to the students at the Faculty of Civil Engineering of Cracow University of Technology. The course has been created by the author and uploaded into the platform [7]. Design process of each web-course typically consists of the following stages [2]:

1. Making up a decision on the course **goals** and **outcomes**. Deciding if the goals **can be reached** by using specific tools applied within the course.
2. Making up decisions on the course **duration**: designing the number of **modules** or the number of **hours** assigned to a course

   3. Making a list of the **activities**, which can be used within the course to reach certain educational goals.

## 2    Teaching /learning outcomes of the Technical Drawing (TD) course

According to the standards set up by the National Qualifications Framework (NQF), the expected teaching/learning outcomes, i.e. the effects of studying TD can be classified into the following categories:

a) **Knowledge**: The graduate will have knowledge of the European and the National Standards of designations and annotations used to prepare both construction and structural design projects.

b) **Skills**: The graduate will have the ability to prepare design projects according to various degrees of accuracy. In particular, special attention will be paid both to architectural and building drawings and to branch drawings (constructional and sanitary drawings, technical drawings for structural metal works and for reinforced constructions).

c) **Skills**: The graduate will have the ability to use any CAD system to create a design project.

d) **Skills**: The graduate will have the ability to use a freehand sketching method to create on-site sketches and notes.

e) **Skills**: The graduate will have the ability to correctly use various projection methods (American and EU methods) in order to create both views and sections of designed structures.

f) **Social competences**: The graduate will be able to communicate design ideas with his/her co-workers and to work in a team.

## 3    TD course duration and its division into module

Typically, the first stage of the course design will require to make a decision of the course content and construction. Basically, when considering the minimum of the content, which should be included in the first year course, the author has decided to divide the content into specific modules [7]:

**MODULE 1: Standardization in Technical Drawing** which includes basic standards regarding line types and line weights, technical lettering, standard drawing sheet sizes, title blocks, drawing areas assigned on the drawing sheets. Within this module a student gets familiar with the basic commands in AutoCAD and prepares a typical *drawing sheet size* with a *title block* and relevant *annotations*.

**MODULE 2: Architectural and Construction Drawings for Civil Engineering.** Basic standards applied to construction drawings together with the relevant scales are introduced here. Principles of *standardized dimensioning*, both and *dimension setup* in AutoCAD for architectural and building drawings are presented here.

**MODULE 3: Construction Drawings: Reinforced Concrete Structures.** Within this module the students get familiar with the designations of reinforcement and also learn how to provide the *Bill of Materials* for a specific reinforced structure. Three various types of rebar (=reinforcing bars) indications have been introduced (coded system, non-coded system and a mixed system), while the coding system itself requires special attention as it consists of two characters described in the standard [8].

**MODULE 4: Steelwork constructions: Mechanical fastening with rivets and bolts.** This module provides information on symbolic designations of various types of bolts and rivets according to the standard [5]. *The technique using executable tutorials* has been applied to create dynamic blocks of various types of rivets/bolts. The strategy how to create such demos has been described in this publication.

**MODULE 5: Steelwork constructions: Welded Joints.** New designations of welded joints have been introduced in the standard [10]. The need for making the students familiar with these has emerged from the practice.

## 4    Activities used as tools to teach TD course

During the **TD** course the students get enrolled into a platform by receiving an access key to a course from the tutor. A wide range of activities available and used to create a blended TD course in the Moodle system comprises the tools especially useful for a self-study process. Specifically, the author of the course created the following modules:

- Forums – the site where most information can be automatically delivered to the students and where the majority of discussion takes place;
- Database activity – which enables a teacher and/or a student to build, display and search for a bank of recorded entries about any topic;
- Choice activity – where the teacher asks a question and specifies a choice of multiple responses;
- Quiz – which allows the teacher to design and set a quiz test consisting of multiple choice, true-false and short-answer questions;
- Assignments – which allow the teacher to specify a task that requires students to prepare digital content in any format and submit it by uploading to the server;
- Glossary – especially useful for the studies in English; this activity allows the participants to create and maintain a list of definitions like a dictionary.

Certainly, there are many other tools, which can be used to teach a TD course like: SCORM, Hot Potatoes test, Lessons, Chats, Surveys and many other possibilities, which are available at hand on the Moodle (not all of them are used in this course though).

## 5    Dynamic blocks and their application in construction drawings

Teaching technique with support of the Moodle system involves delivery of tutorials to the students through the Internet medium. The short, introductory lectures on specific topics are delivered to the students within the classroom; they only impart a basic knowledge on the principles for creation of specific types of drawings. The content for the lectures of **TD** course has been delivered in a *.pdf format to make a database available through the system (=Database Activity). What is more, software demonstrations have been created with aid of the **TurboDemo** software and later inserted into the Moodle environment. A detailed description of how to create a dynamic tutorial has been described below. Graphical designation of various rivets of different sizes has been taken into account when creating the tutorial files.

**Step 1: Drawing a symbol of a rivet** in AutoCAD

Dynamic blocks have been used to provide an easy example of the designations of rivets. Symbolic representation (Table 1) of various types and sizes of rivets and their application into construction and technical drawings has been included in the National Standard PN – 64/B – 01043 [5]. In AutoCAD software we create a basic drawing of a rivet's symbol, which will be a circle of a specified diameter. Then we draw two mutually perpendicular diameters. We add a hatch of a *solid* type and black in color separately to each of the quarters of the circle. We also add the specific designations of the diameters as a textual piece of information (e.g. rivets of diameter ø11, ø21, ø31, ø37mm – Table 1). All the drawing entities should be placed in the relevant layers. Finally, we save a block under a specific name ("**rivets**").

**Step 2: Creating a dynamic block: adding parameters and activities**

Let us now create a dynamic block of our rivet. Within the command *bedit*, we add now the parameter "**linear**" and assign the "**scale**" action to this parameter. Before we make a **list** of the required **values** for a radius, we need to make one of the grips of the linear parameter to become non-active. Thus, we highlight the linear parameter and then we right-click on the mouse button. From the available menu, we choose "show one grip" option. Now we continue with the *List edition*. With the linear parameter highlighted, we display the *Properties Palette* (combination of the buttons: *CTRL+1*) and we insert the required values for different diameters of the holes.

**Step 3: Using "Visibility States" in a block**

Let us now use the "**Visibility state**" parameter to distinguish between various types of rivets. This is especially important if we consider all the symbols used for the rivets with no internal hatch applied (Table 1: compare the symbols used to designate the rivets of diameters ø10, ø20, ø30 and ø36mm). We define various visibility states of hatch and text; to give an example, the state "**none**" will be assigned to all the rivets with no hatching, "**all**" will be assigned to the rivet ø 12, "**half**" will be assigned to the rivet ø 16, which has been only hatched by half, and a "**quarter**" will be assigned to the rivet ø 24 (Table 1). To provide an adequate visibility of the proper text to the various sizes of the rivets we will use the commands: *bvshow* and *bvhide*. Based on the blocks created earlier, we can distinguish between the visibility states: "none11", "none21", "none31", "none37" by hiding or making visible respective sizes assigned with the certain rivet size.

**Step 4: Creating a Lookup Palette**

Now we can create the **Lookup Palette**. In the **Lookup Palette** we can add the **Properties**, which have been earlier created as the **Linear parameter** (=distance) and the **Visibility parameter**. We assign correct terms to respective parameters to describe various types of rivets.

**Step 5: Creating a dynamic presentation in a TurboDemo**

The author, using the **TurboDemo** software, has developed a few presentations in a form of software demonstration to show how one can create and edit dynamic blocks (the files such as: **draw_rivets.exe** or **rivets_bedit**.exe). The files have been uploaded into to the Moodle environment [7]. As these files are of the executable nature they are easy to handle by the students. Not only the *.exe files can be created within the TurboDemo but also the Flash files (*.swf) or the animated *.gif files. To the list of possibilities we can add the files for the Windows Media Player ( *.asf), the avi-video files and the text files such as the files for Word editor and also the graphic files (*.bmp, *.jpg, *.gif.).

| Table 1: Rivets: Symbolic Representation according to Standard [5] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Diameter of a raw rivet $d_n$ [mm] | 10 | 12 | 16 | 20 | 24 | 30 | 36 |
| Diameter of a hole ø [mm] | 11 | 13 | 17 | 21 | 25 | 31 | 37 |
| Designation in a top view |  11 |  |  |  21 |  |  31 |  37 |

Similarly, the educational files presenting how one can create and designate various types of bolts and their designation (file: bolts_exe) have been created.

## 6    Conclusions

Modern teaching technology has become more stimulating to our students than before. The students tend to actively explore the new than to passively acquire packages of new information during the traditional lectures in the school classroom. A blended introductory **Technical Drawing** course has been implemented for three years. The motivation for developing online content resulted from various reasons. The main point was that the students are always searching for the most effective way to acquire information. In this paper the author describes the new tool (TurboDemo software) to create "CAD software" demonstration. Online instruction and the effect of "blended-learning" has become significant in terms of teaching efficiency. The students at our university are stimulated to work with the support of the Internet and they are expected to expand co-operation with their teachers on the bases of the Moodle system.

## References

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# MULTIMEDIA W ZDALNYM NAUCZANIU PRZEDMIOTÓW TECHNICZNYCH

Dydaktyka przedmiotów **Rysunek techniczny**, **Grafika inżynierska**, **Projektowanie wspomagane komputerem**, które są przedmiotami z grupy tzw. przedmiotów **kierunkowych** na pierwszych latach studiów inżynierskich we wszystkich uczelniach technicznych, wymaga zaznajomienia studentów z aktualnymi normami dotyczącymi zasad oznaczania na rysunkach konstrukcyjno budowlanych, mechanicznych, czy architektoniczno-budowlanych [1]. Student znajduje się w sytuacji, kiedy nie zna jeszcze podstaw projektowania, mechaniki ustrojów konstrukcyjnych, prawa budowlanego a jednocześnie zgłębia podstawy metod CAD, czym najczęściej okazuje się praca w programie AutoCAD. Zintegrowane nauczanie w postaci tzw. „blended-learning", czyli nauczanie za pomocą platformy Moodle (*ang*. Modular Object-Oriented Dynamic Learning Environment) wychodzi studentom naprzeciw. Jest to jedna z najbardziej popularnych platform e-learningu typu open-source, udostępniana darmowo w ramach publicznej licencji GNU GPL [2]. W niniejszej pracy zaprezentowano materiały instruktażowe w postaci plików typu *.exe lub plików programu Flash (*.swf), które zostały utworzone i umieszczone na platformie [7] celem wspomagania dydaktyki przedmiotu „Rysunek techniczny i grafika komputerowa" adresowanego do studentów I roku studiów

**niestacjonarnych** Wydziału Inżynierii Lądowej PK oraz dla kursu o nazwie „Technical drawing" adresowanego do studentów I roku studiów **stacjonarnych** tego samego wydziału, lecz studiujących budownictwo w języku angielskim.