

**Erasmus+ Programme KA2 Strategic Partnership Project „Development of
Interactive and Animated Drawing Teaching Tools”**

N° 2017-1-LT01-KA202-035177

The Report of the Needs Analysis Survey



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1. Acknowledgements

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Monika Sroka-Bizon, Silesian University of Technology, Poland,

and all the partners team members who assisted with the survey, including development of the questionnaires, translation and promoted and distributed the survey to its members throughout the country for completion.

2. Executive Summary

From the 1st of October 2017, an international Erasmus+ project has been launched, the main objective of which is to develop interactive and animated teaching material (computer version) that would facilitate/ assist students of vocational schools, colleges and universities in learning (mastering) the technical drawing material better.

The aim of this survey was to study the methodology of teaching the subject matter of the project partnering countries (Estonia, Latvia, Lithuania, Poland, and Slovakia), the relevance of the taught chapters, the standards applied, the use of signs and symbols.

Three questionnaires for different target groups were prepared in English:

“Teaching of Technical Drawing” – for teachers (Appendix 1);

“Learning of Technical Drawing” – for students (Appendix 2);

“Importance of Technical Drawing in the labour market” – for employers (Appendix 3).

All questionnaires were translated to Estonian, Latvian, Lithuanian, Polish and Slovak languages and were shared between different target groups respondents in Estonia, Latvia, Lithuania, Poland and Slovak from the 17th of January to February 1st, 2018.

The survey was carried out through the platform: <https://pollmill.com/>

We received 56 filled questionnaires from employers, 149 – from teachers and 349 from students. The number of respondents among countries was not evenly distributed. The most answers from employers and teachers were from Lithuania and – students from Latvia.

An analysis of the results of the survey showed that the technical drawing of consistent and qualified training is important for the labor market. Most lecturers and students said that it should be compulsory for all or, at least, the later optional engineering specialties already in secondary school. The technical drawing course should not be integrated into other courses and given more time. Practical work must be organized in small groups of 12-15 students. Employers say that the ability to draw freehand sketches is important. When teaching the use of CAD systems, not only the ability to perform the drawing or modeling functions must be trained, but also the personalization, preparation of drawings for print capabilities.

When preparing the training material, more attention should be paid to:

- Scales, lines and dimensioning;
- Inscribing any polygon in each circle, curves and smooth connections;
- Identifying objects from an orthographic projection drawing, cuts and sections creation;
- Detail and assembly drawing creation, specification of assembly drawings;
- Drawing of elevations, plans and cross sections.

3. Background and objectives

The project's principal objective is to develop Technical Drawing teaching material (computer version), which would facilitate vocational schools, colleges, universities students in learning (mastering) the drawing teaching / taught material better. Technical Drawing teaching material will be prepared in accordance with the training thematic plans and provide an opportunity to learn to draw both by hand and computer.

We found some information about Technical Drawing training actualities we found in earlier investigations. A survey of employers in Slovakia showed that the issue of re-qualification of vocational school graduates is relevant, there is insufficient knowledge of Technical Drawing, work with software fields, insufficient skills in the areas of standards and technical documentation, measurement methods (Evaluation, 2015). In Poland, a survey of employers and teachers about the need for technical professions in the labor market has shown that “in companies’ representatives opinion the main problem is establishing successful cooperation with schools and insufficient focus of teaching to meet the needs of the modern labor market”. “Teachers’ representatives consider hard realities of polish school and an inflexible educational system” (Matuszak, 2012).

The aim of this survey was to study the methodology of teaching the subject matter of the project partner countries (Estonia, Latvia, Lithuania, Poland, Slovakia), the relevance of the taught chapters, the standards applied, the use of signs and symbols, vocational school graduate's level of preparation to labour market requirements. The results of the survey will be used for the content of the training material, preparation of recommendations for training methodologies and other Technical Drawing problems solution.

4. Survey method

The survey was organized in five countries: Estonia, Latvia, Lithuania, Poland, Slovakia. The following target groups were tested:

1. Vocational school, college and higher education students.
2. Vocational schools' teachers, college and higher education lecturers, scientists.
3. Employers, Labour Market Representatives.

Three questionnaires for different target groups in English were prepared:

“Teaching of Technical Drawing” – for teachers,

“Learning of Technical Drawing” – for students,

“Importance of Technical Drawing in the labour market” – for employers.

All questionnaires were translated to Estonian, Latvian, Lithuanian, Polish and Slovak languages and were shared between different target groups respondents in Estonia, Latvia, Lithuania, Poland and Slovak from 17th of January to February 1st, 2018.

The survey was carried out online through the platform: <https://pollmill.com/>

Information about the survey was shared through the teams of the partner countries as well as through the contacts of the BALTGRAF association.

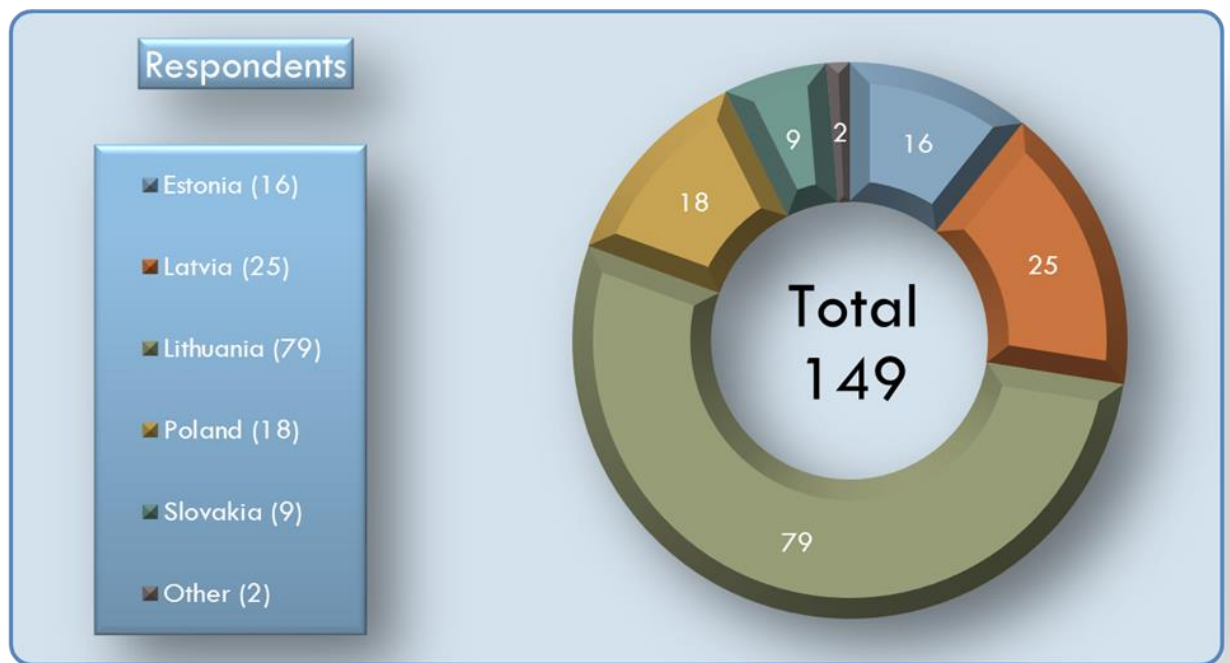
We got 56 filled questionnaires from employers, 149 – from teachers and 349 from students.

Based on the data collected from all the countries' questionnaires, the average values were calculated and are presented in the report below.

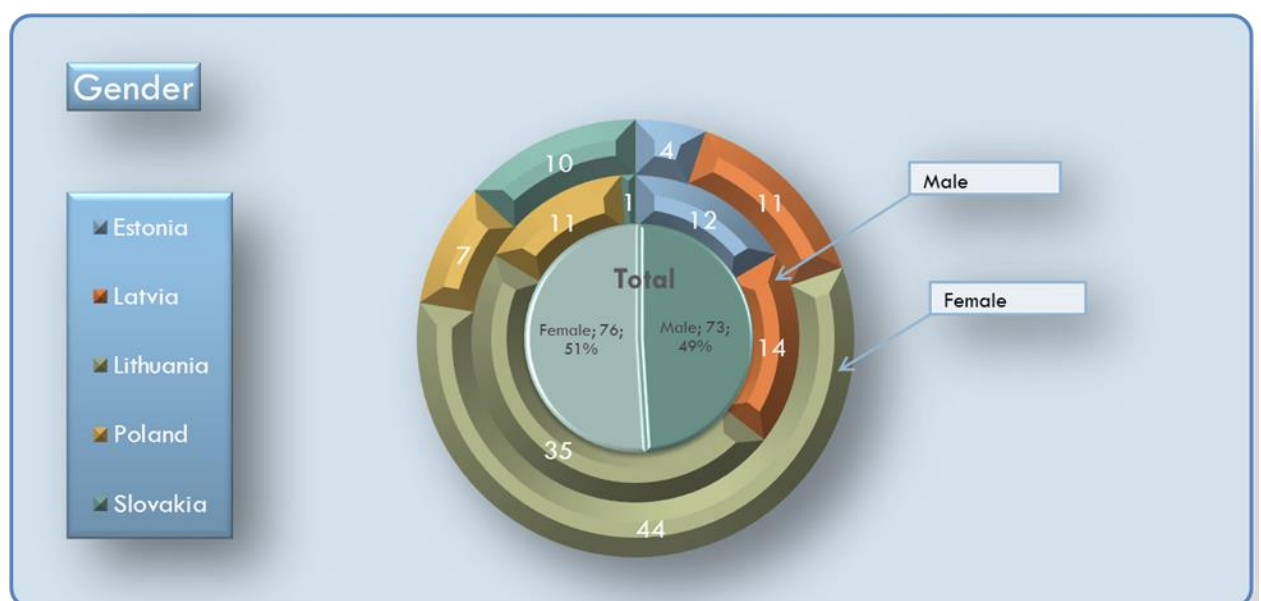
5. Survey results

5.1. Teaching of Technical Drawing

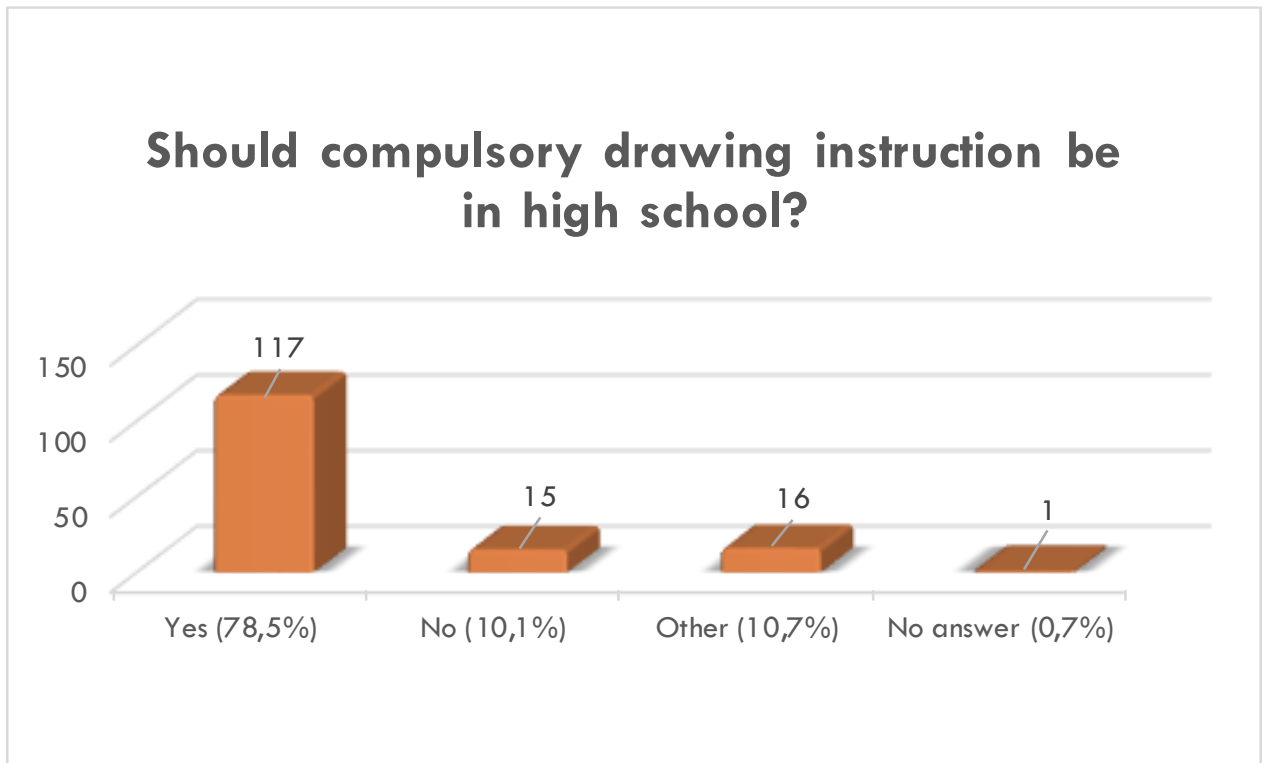
We received 149 questionnaires from the technical drawing tutors. The number of respondents among countries was not evenly distributed. We got the most answers from the teachers in Lithuania:



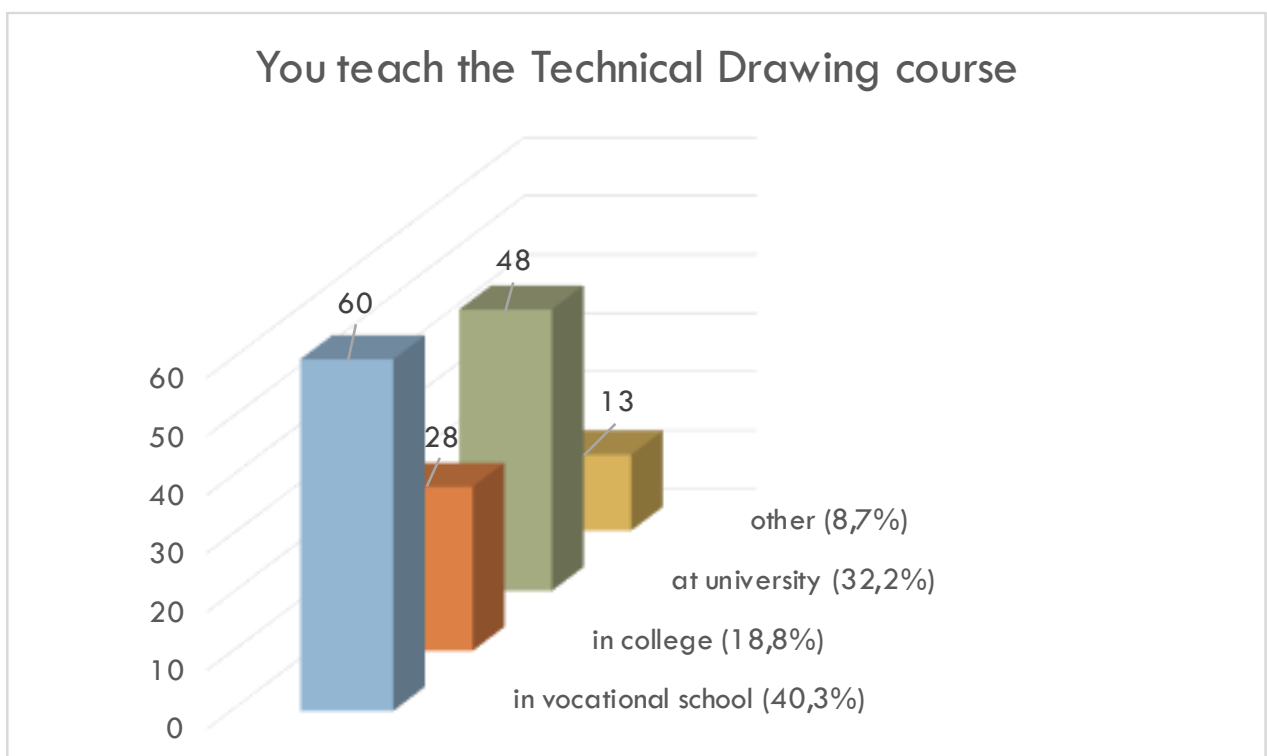
By gender, the total number of respondents was roughly equal:



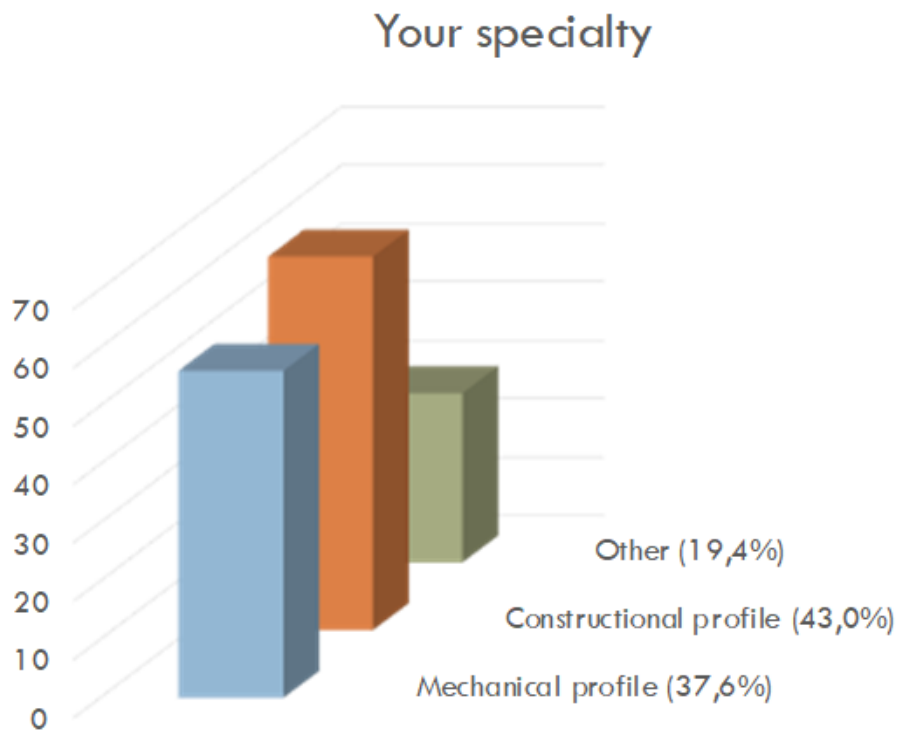
Most of the lecturers spoke in favor of the Technical Drawing compulsory instruction in the high school:



Questionnaires were mostly answered by teachers from vocational schools and universities:

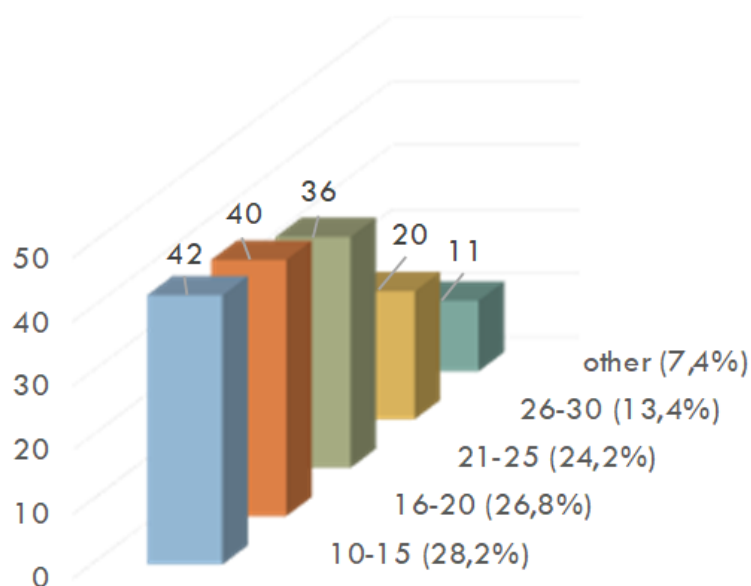


The survey involved both mechanical and construction professionals:

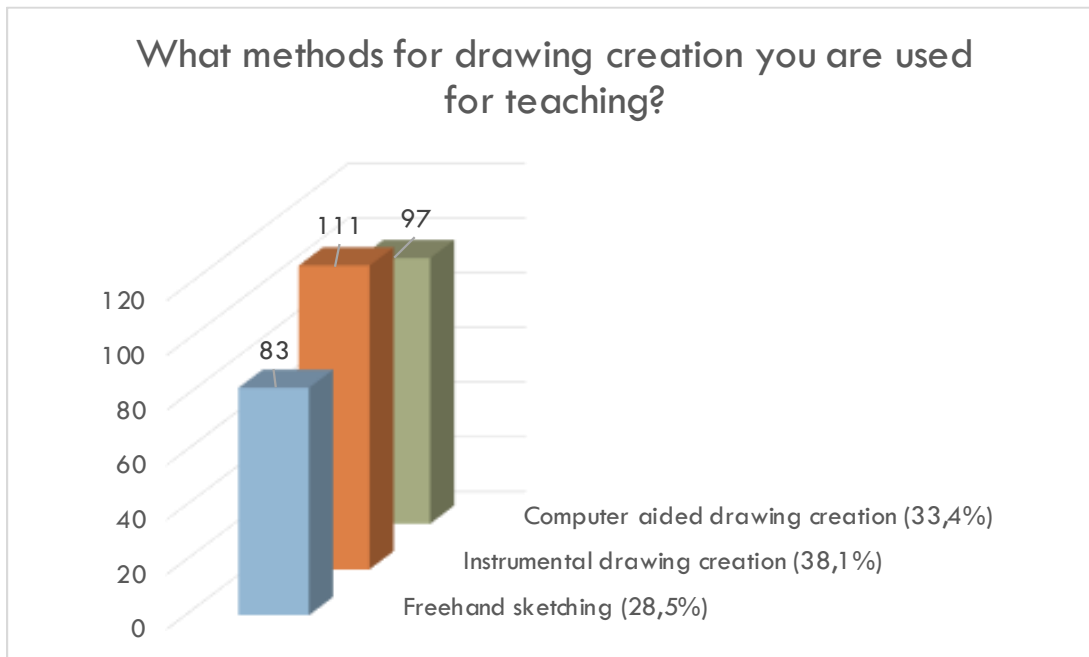


During practical work, lecturers work with different size groups, but often these are clearly too large:

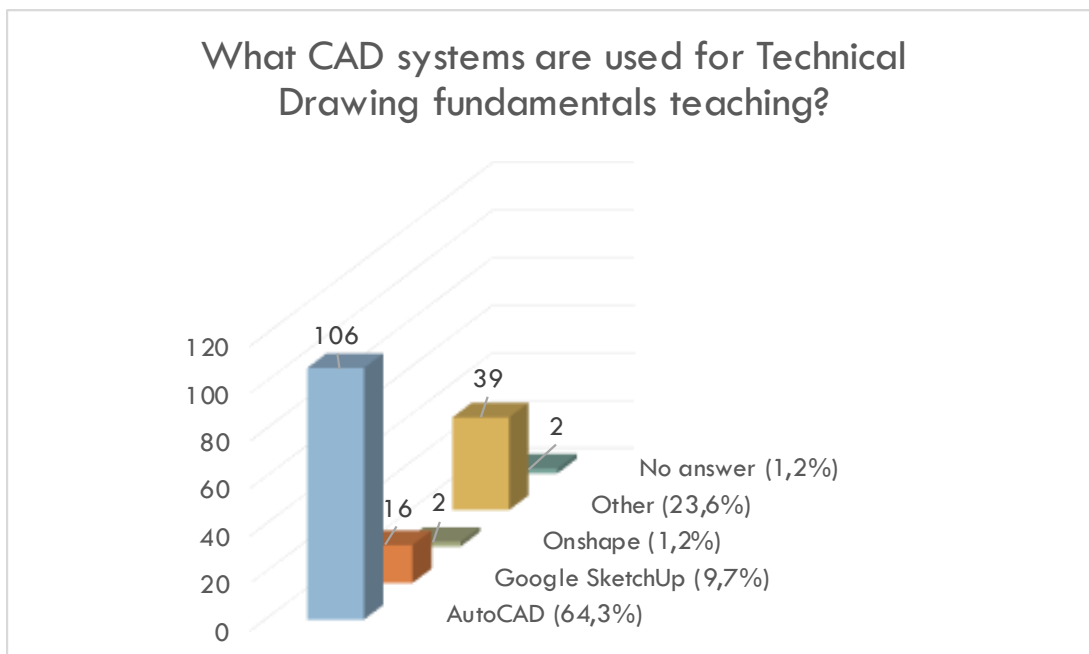
How many learners it is in the group during practical work?



For drawing creation both freehand sketching and manual instrumental drawing are used and a computer aided drawing, but attention is drawn to the very often used manual drawing:

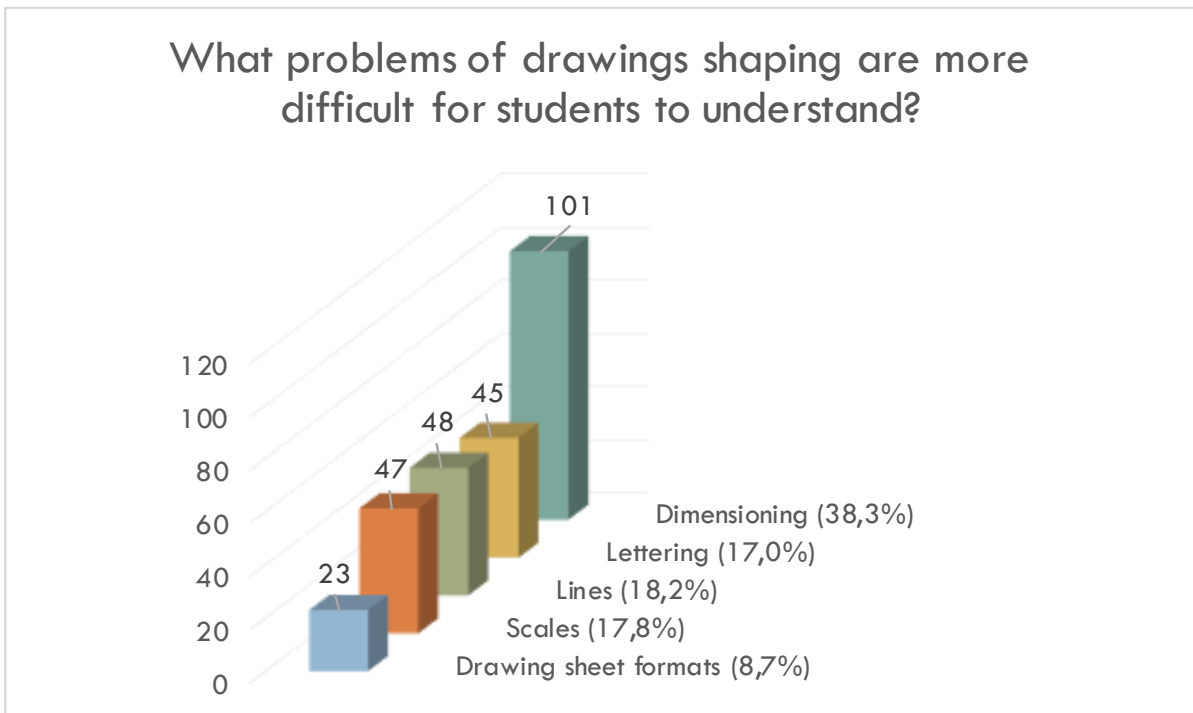


As most often CAD system used for Technical Drawing fundamentals teaching is AutoCAD:

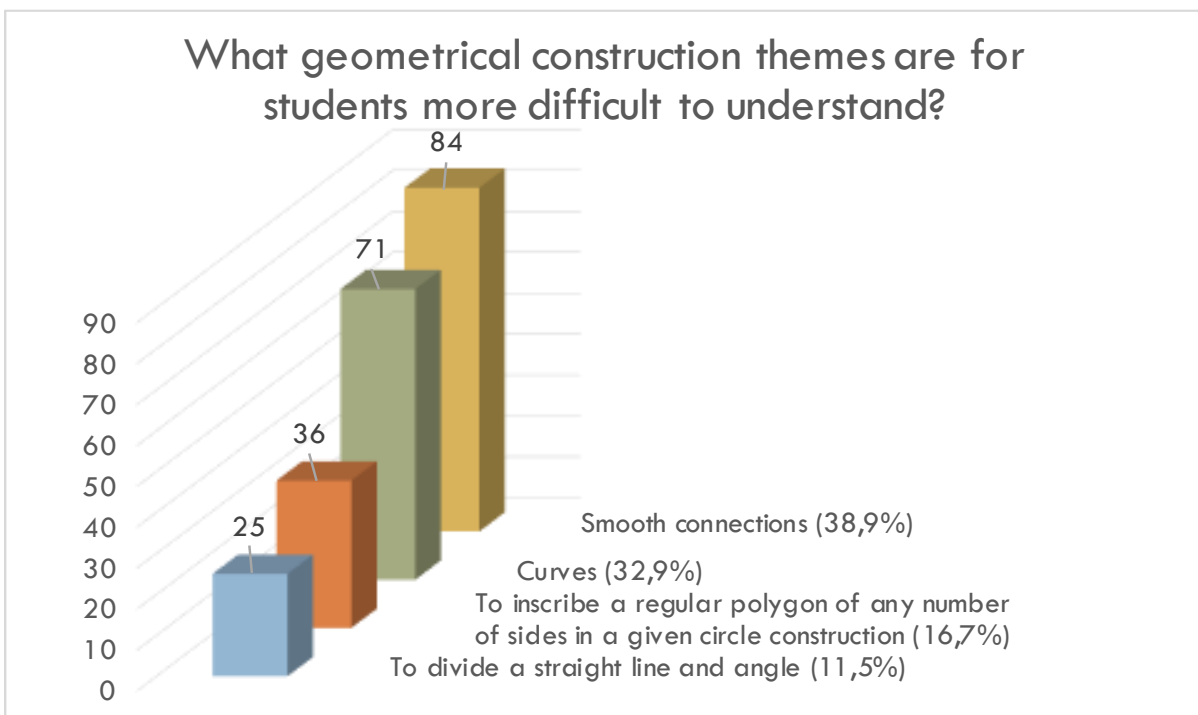


Other programs used are more often mentioned: SolidWorks, GeoGebra, ArchiCAD, Autodesk Inventor.

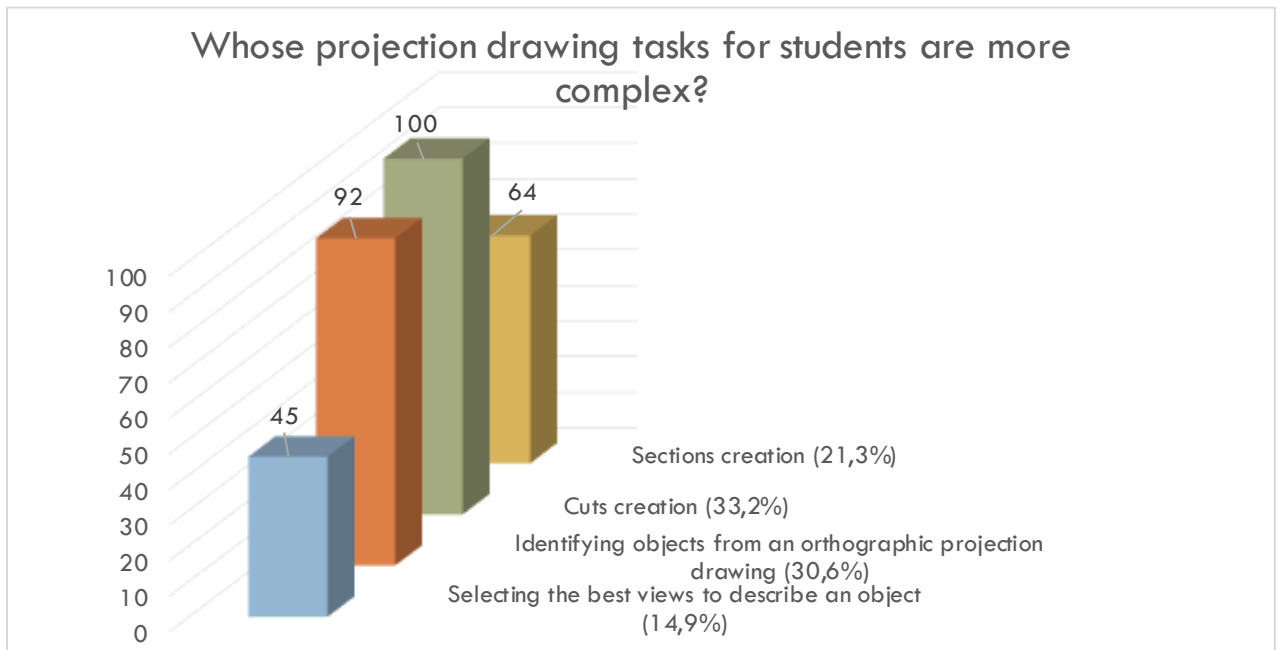
The teachers named dimensioning as most difficult problem of drawing shaping for students to understand:



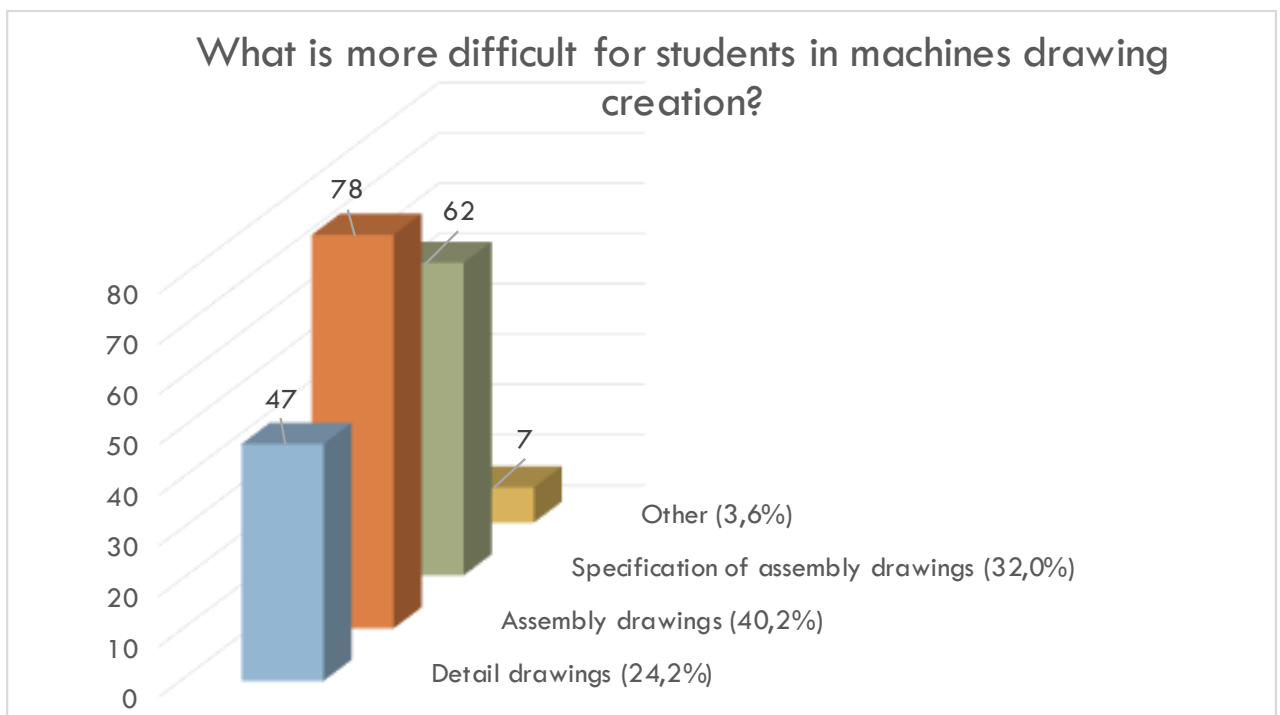
Smooth connections and curves according to teachers' opinion are geometrical construction themes that are more difficult to understand for students:



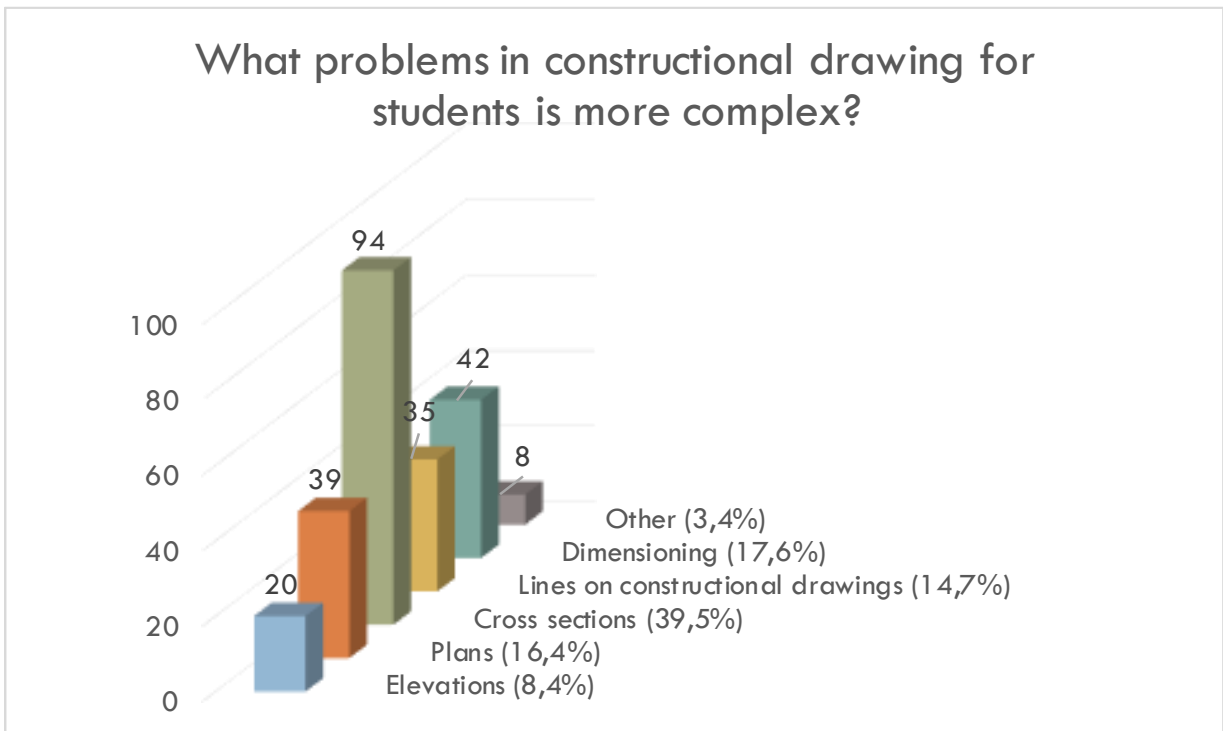
According to the lecturers, all the projection drawing themes are complex for students, but the most complex ones are creation of cuts and identifying objects from an orthographic projection drawing:



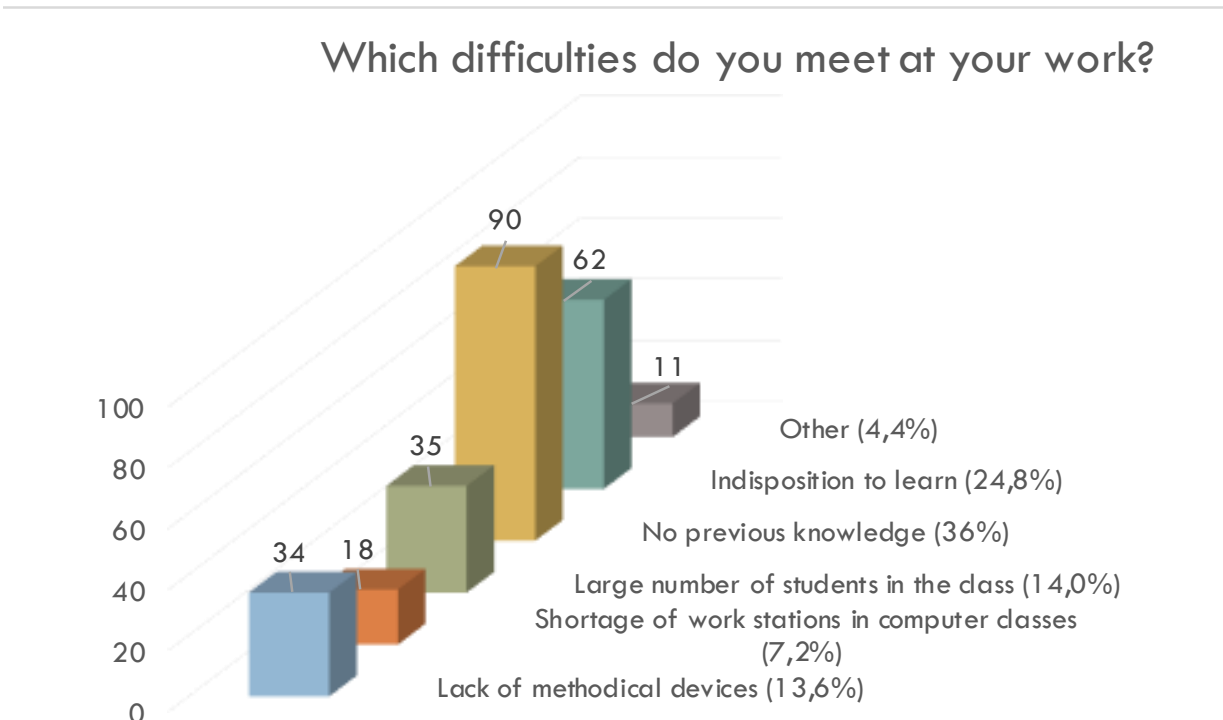
It seems that a lot of attention must be paid to all issues of machine drawing, but most of all to assembly drawings and specification of assembly drawings:



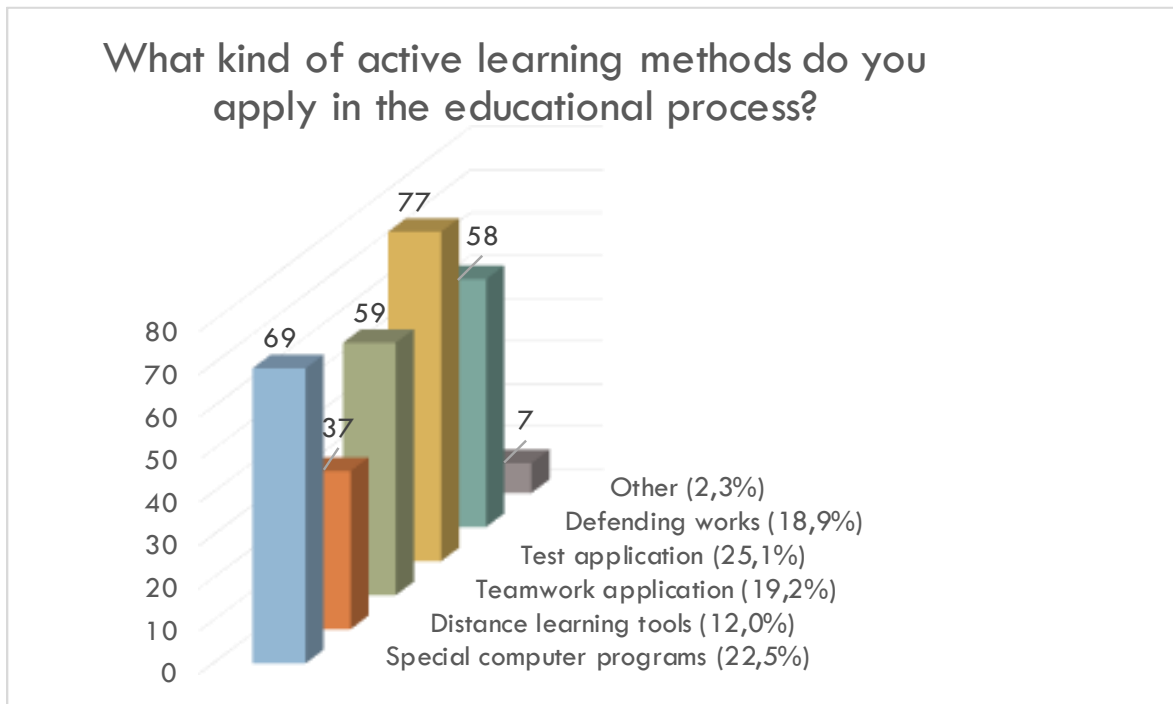
Teachers from the constructional drawing chapter distinguish cross-sectional drawing as the most difficult task for students to understand:



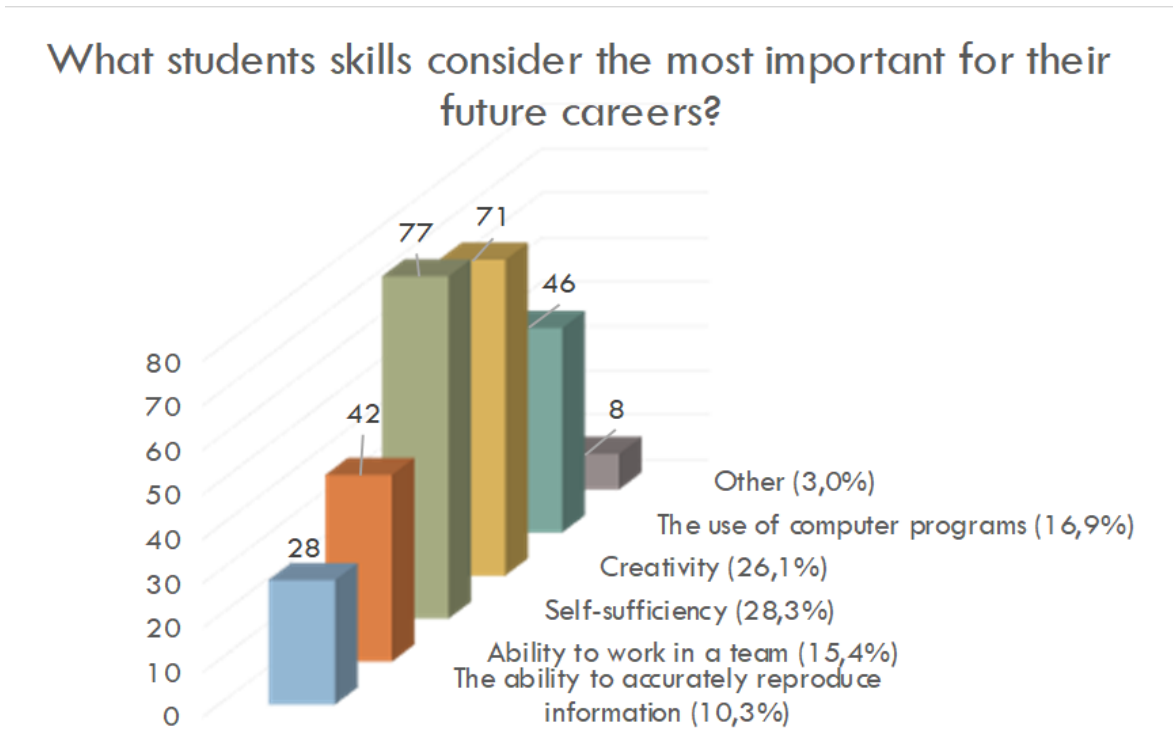
The lack of knowledge and the indisposition to learn are two major difficulties faced by lecturers:



Various forms of active learning are used in the learning process, but attention should be paid to the common use of tests:



Self-sufficiency, creativity and the use of computer programs are named as the most important student skills for their future career:

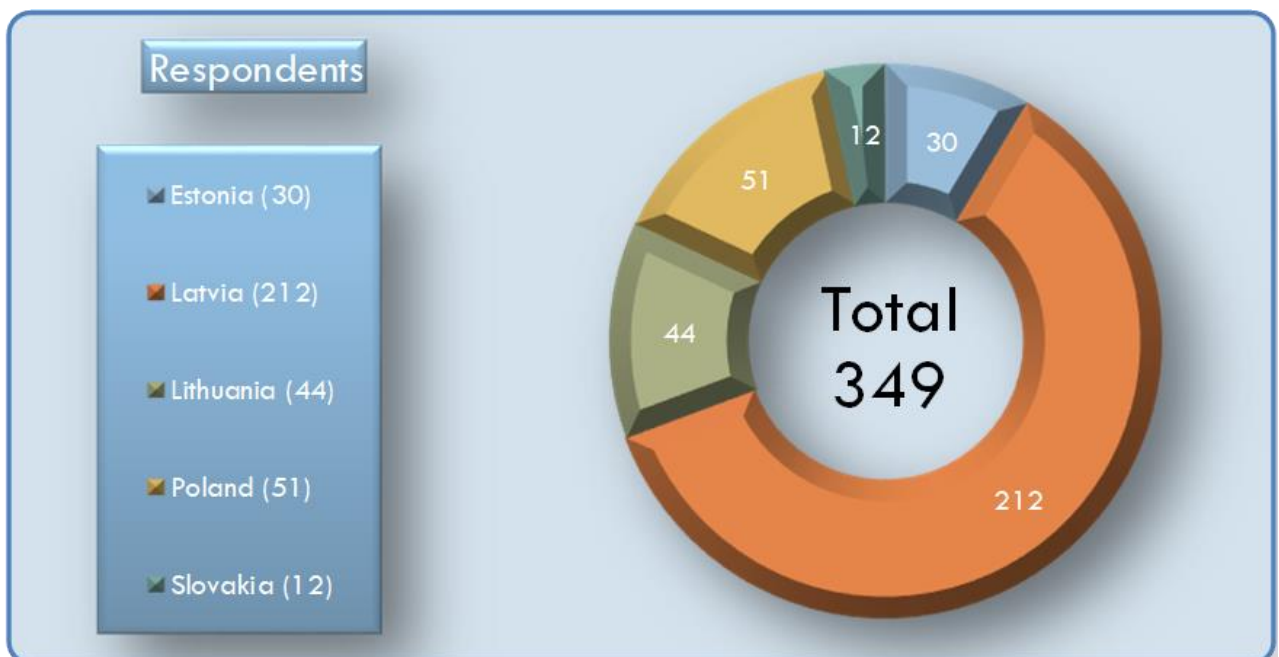


Other suggestions (problems) that did not reflect on the questions were proposed to the project development:

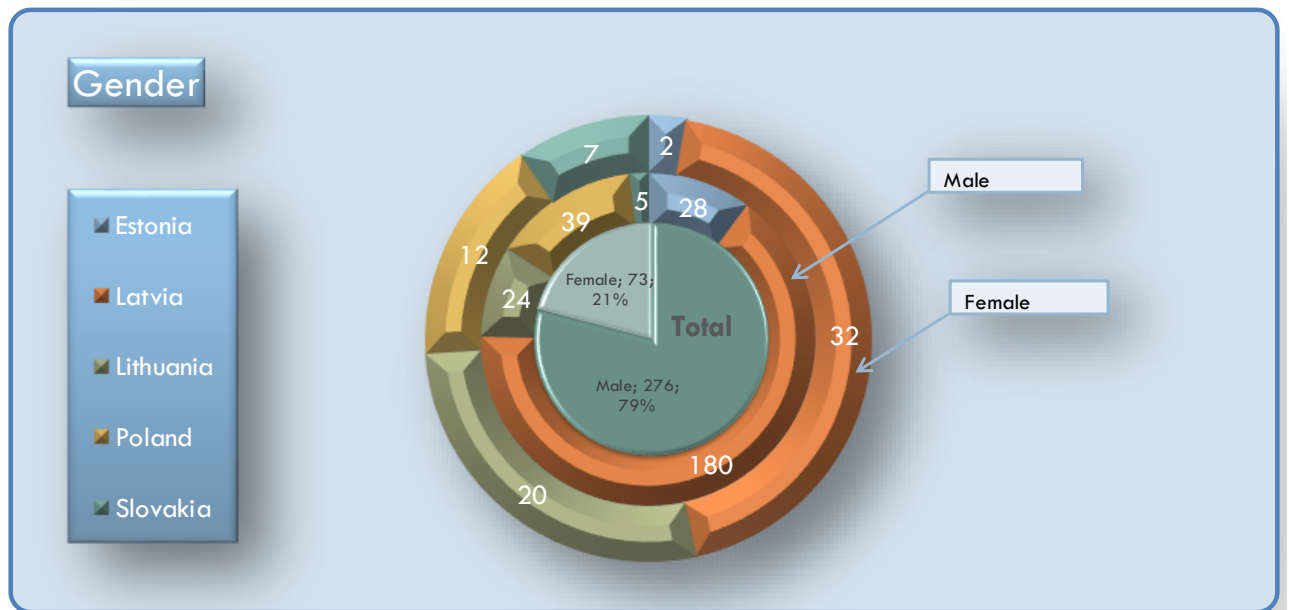
- Constant pressure by management to reduce the number of hours and the volume of substance in the contact.
- There should be a continuous drawing training course.
- It is important that the knowledge and skills acquired continue to be consistently applied in the study of other engineering subjects.
- Not enough time for learning this subject.
- To individualize learning.
- The ability to use a technical drawing for technical profiles should be obligatory and treated on a par with mathematics and physics.

5.2. Learning of Technical Drawing

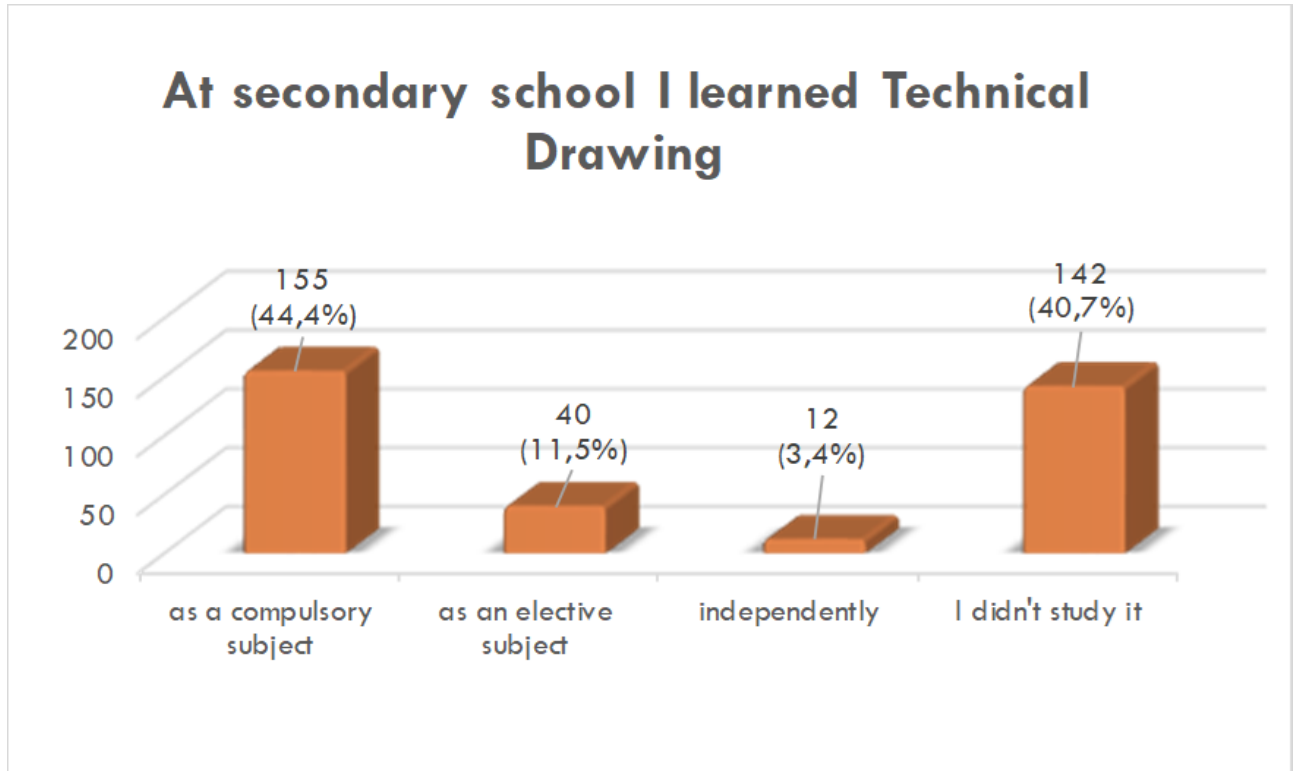
We got 349 filled questionnaires from students. Number of respondents among countries was not evenly distributed. The most answers from students we got were from Latvia:



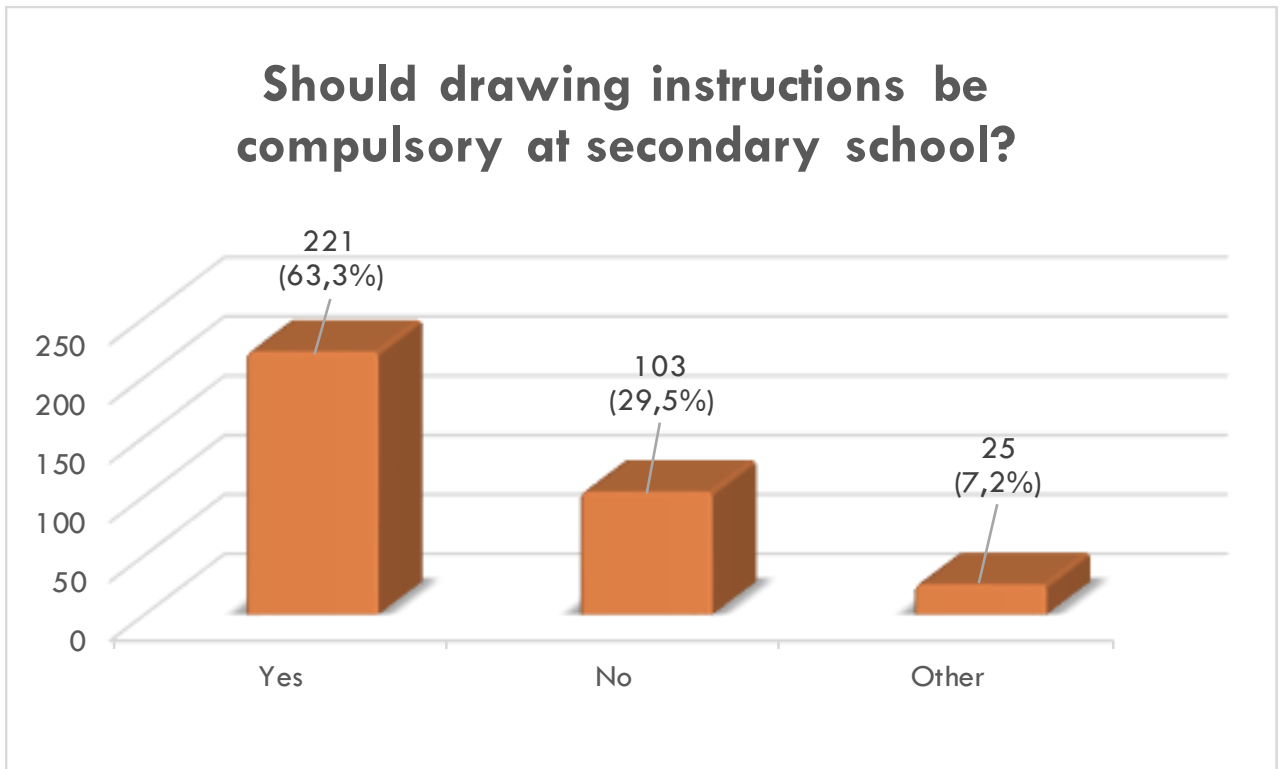
Most of the respondents were male:



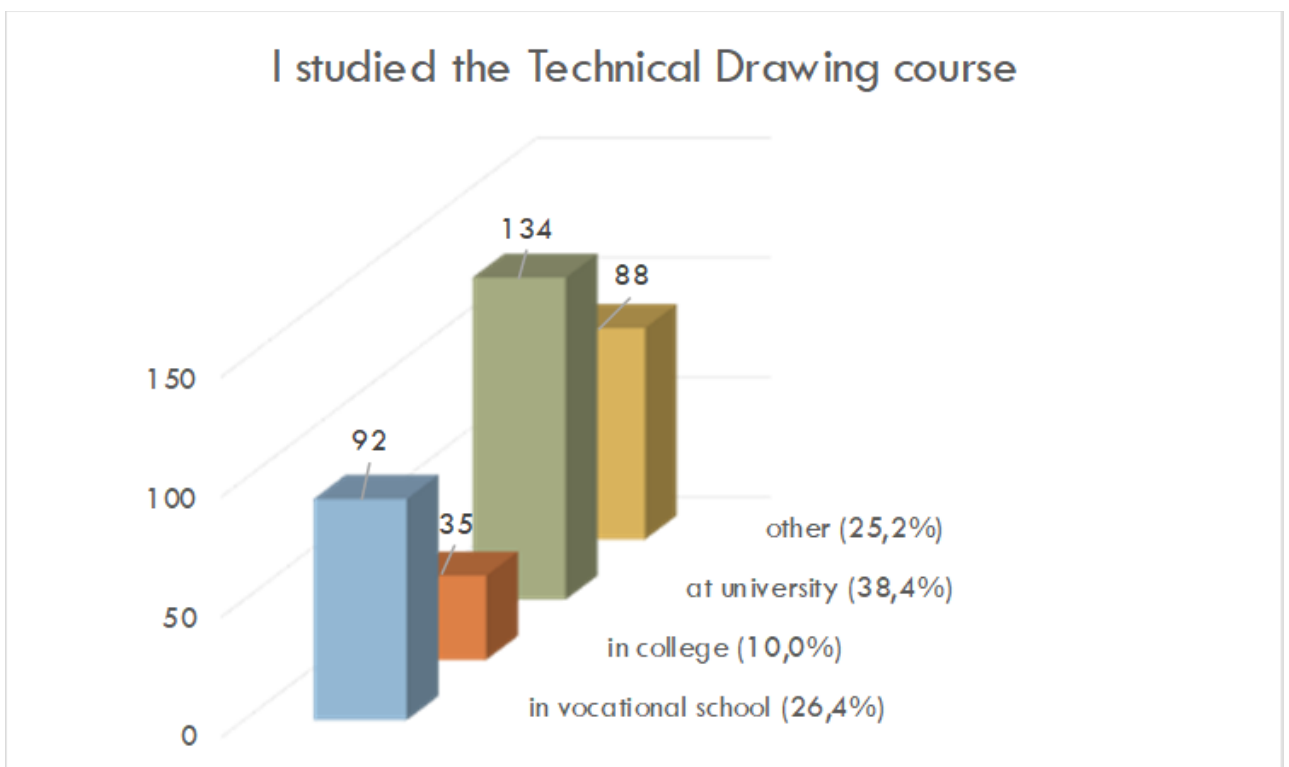
Almost half of them did not learn drawing at secondary school:



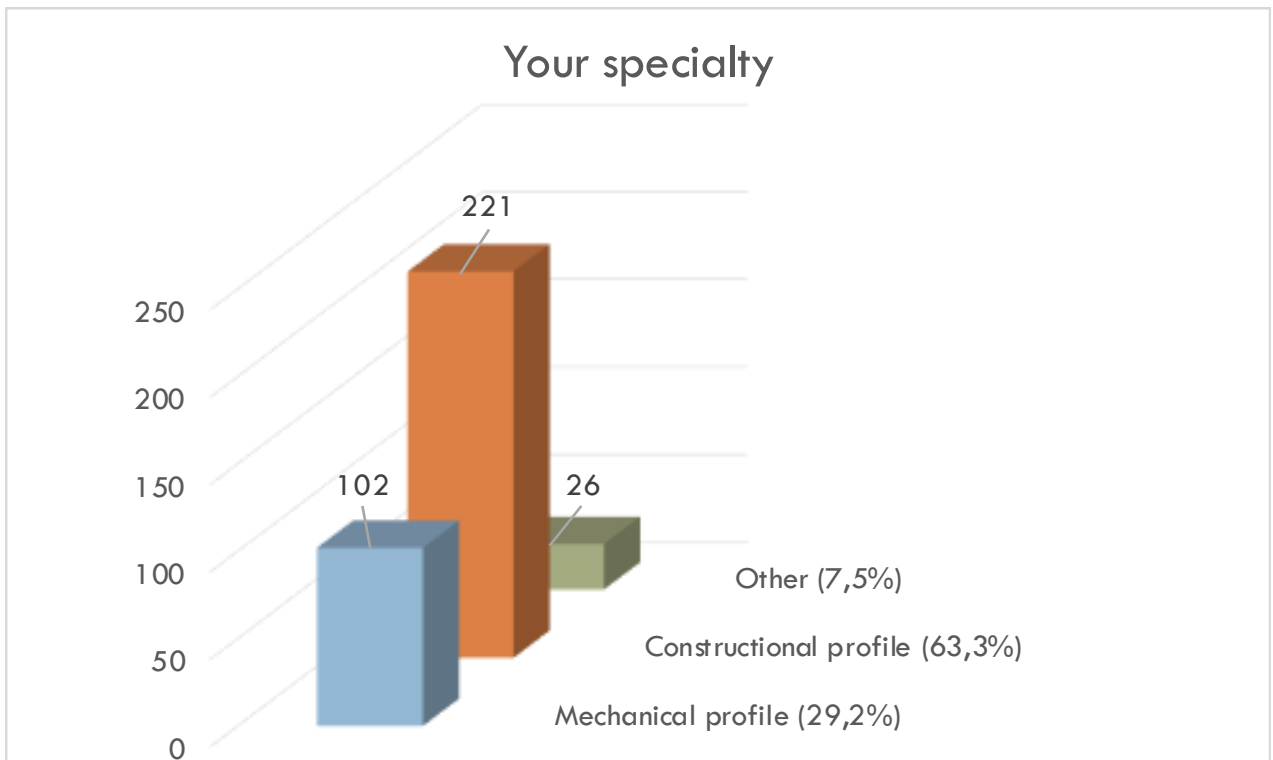
Most of them think that drawing instruction in secondary school should be compulsory:



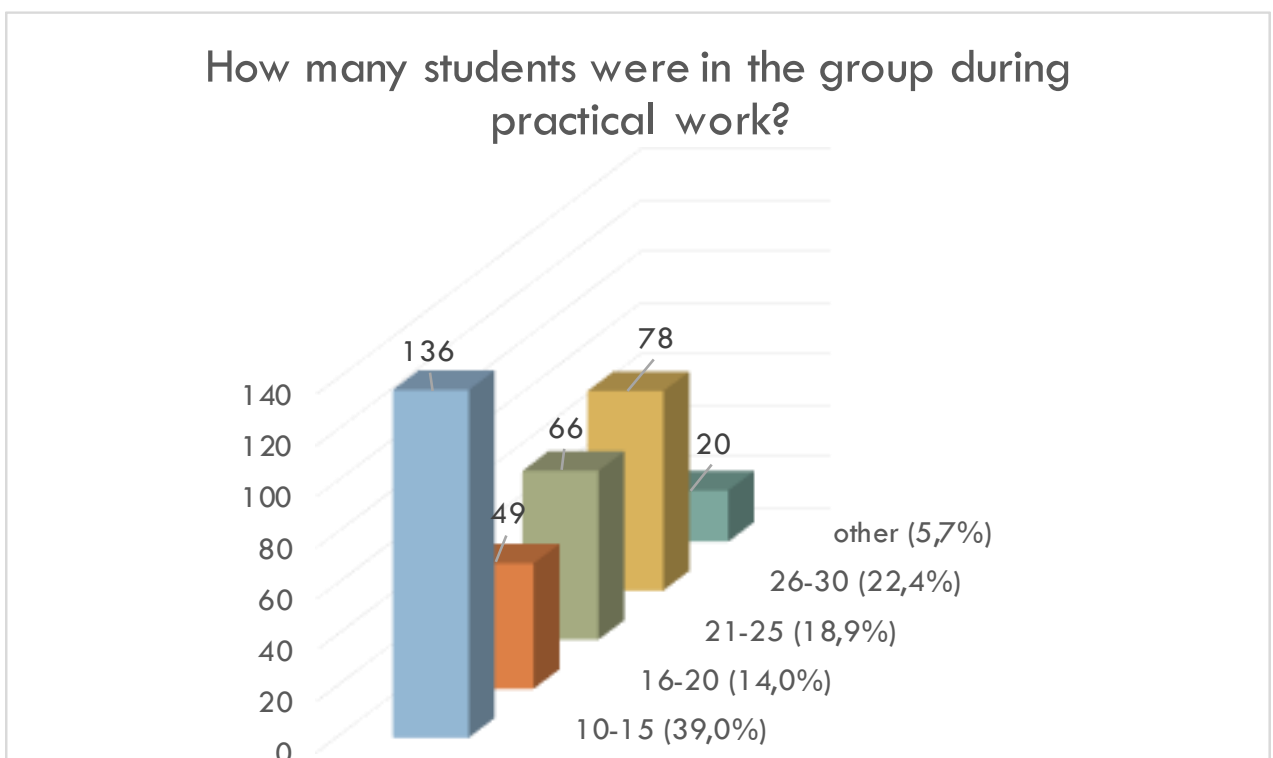
Questionnaires were filled by representatives of various educational institutions. Of the other choices, most indicated that drawing was taught at technical school:



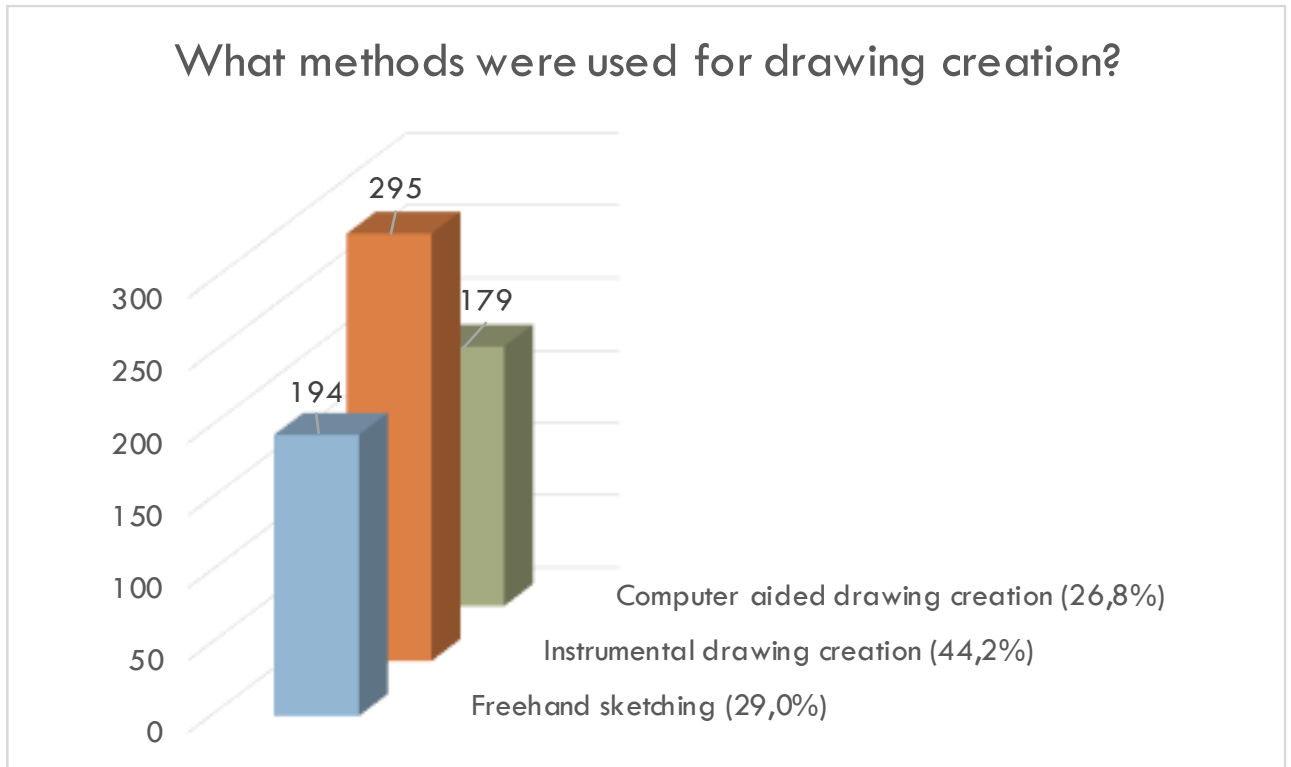
Most of the respondents have a constructional profile specialty:



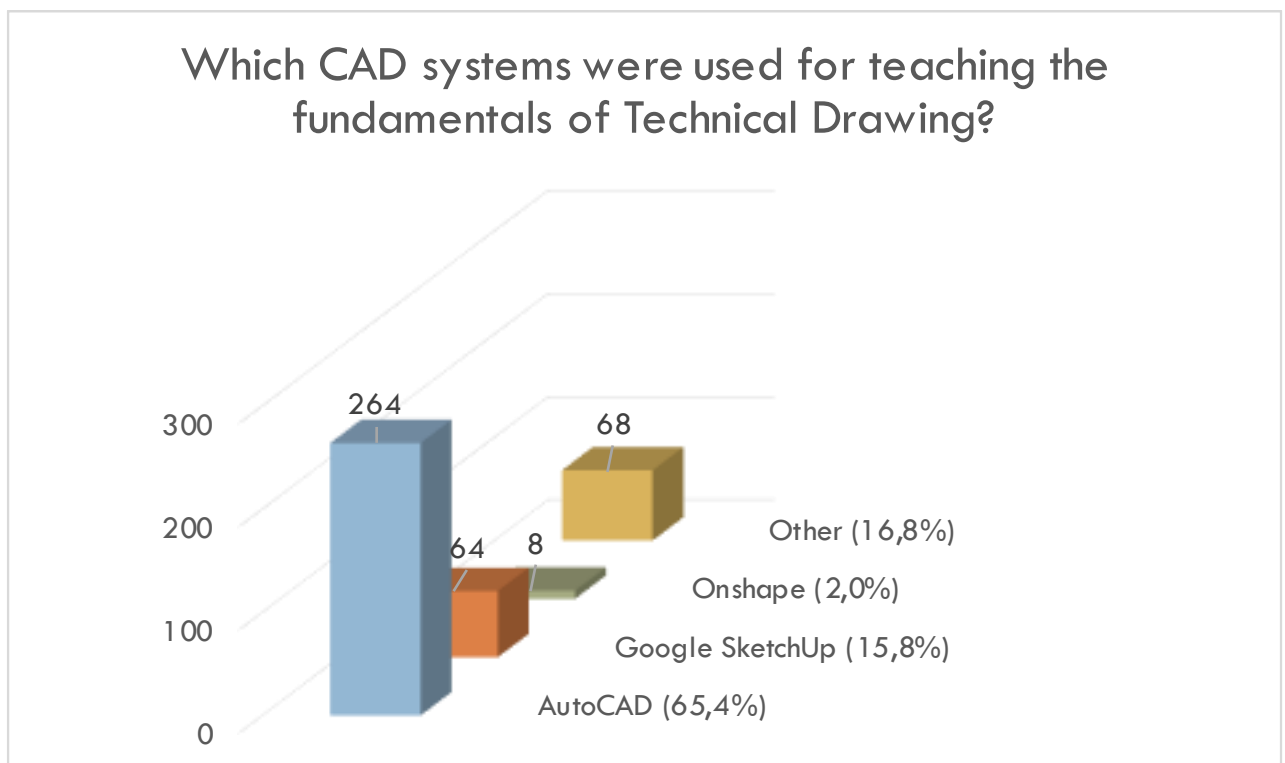
Attention is drawn to the fact that a significant proportion of students do their practical work in relatively large groups:



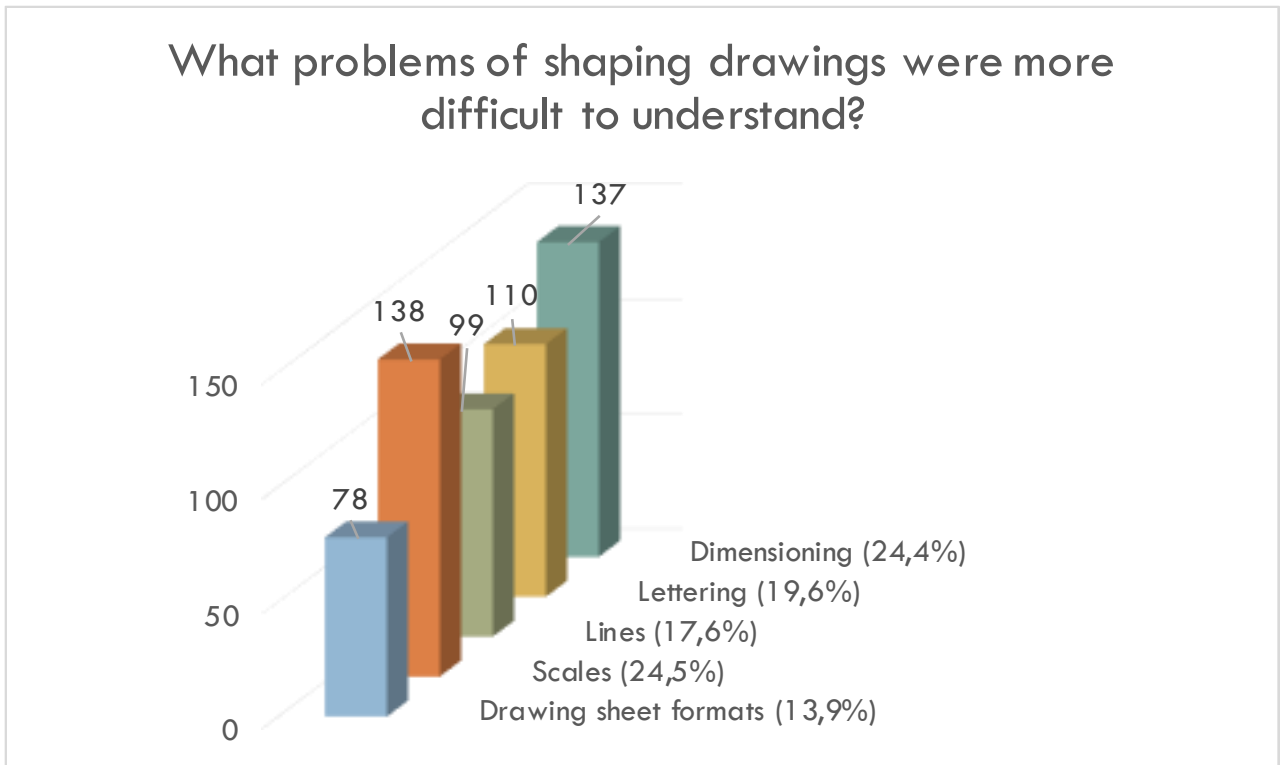
Instrumental drawing creation is named as the most commonly used method for drawing creation:



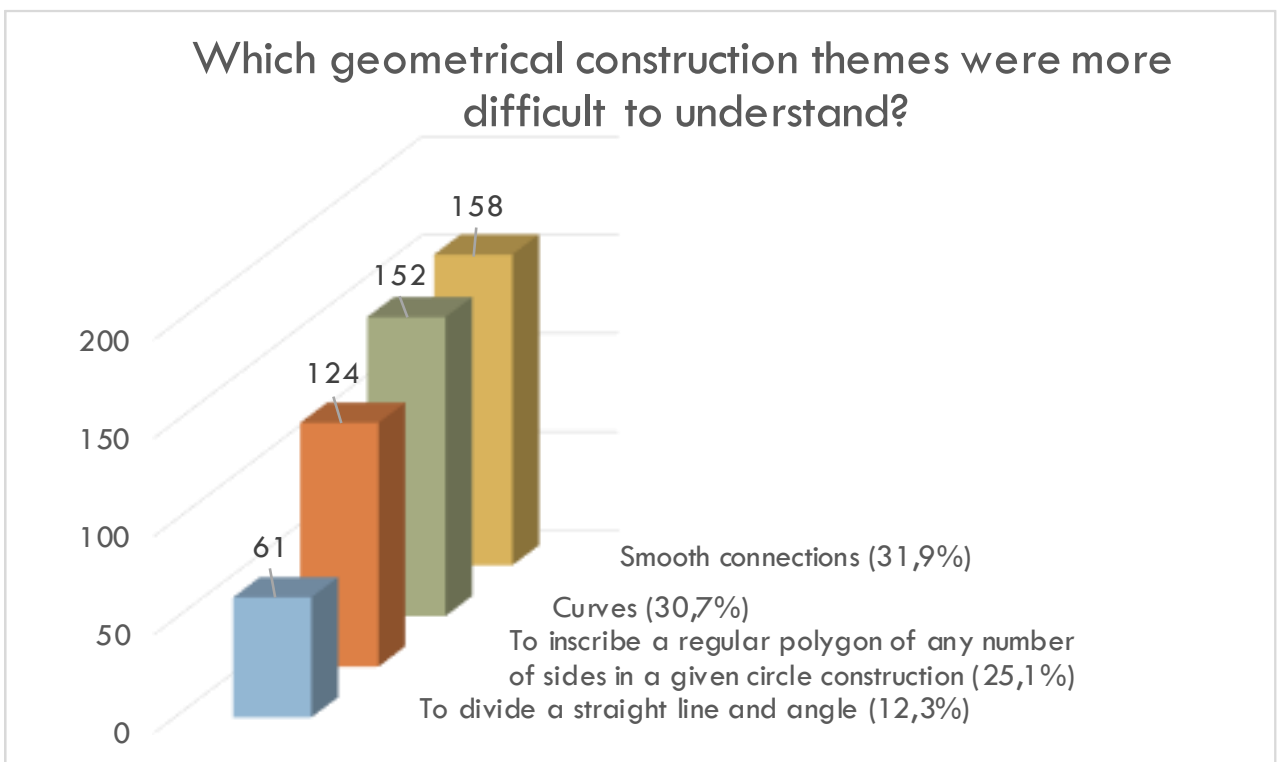
The predominant system of Technical Drawing training is AutoCAD:



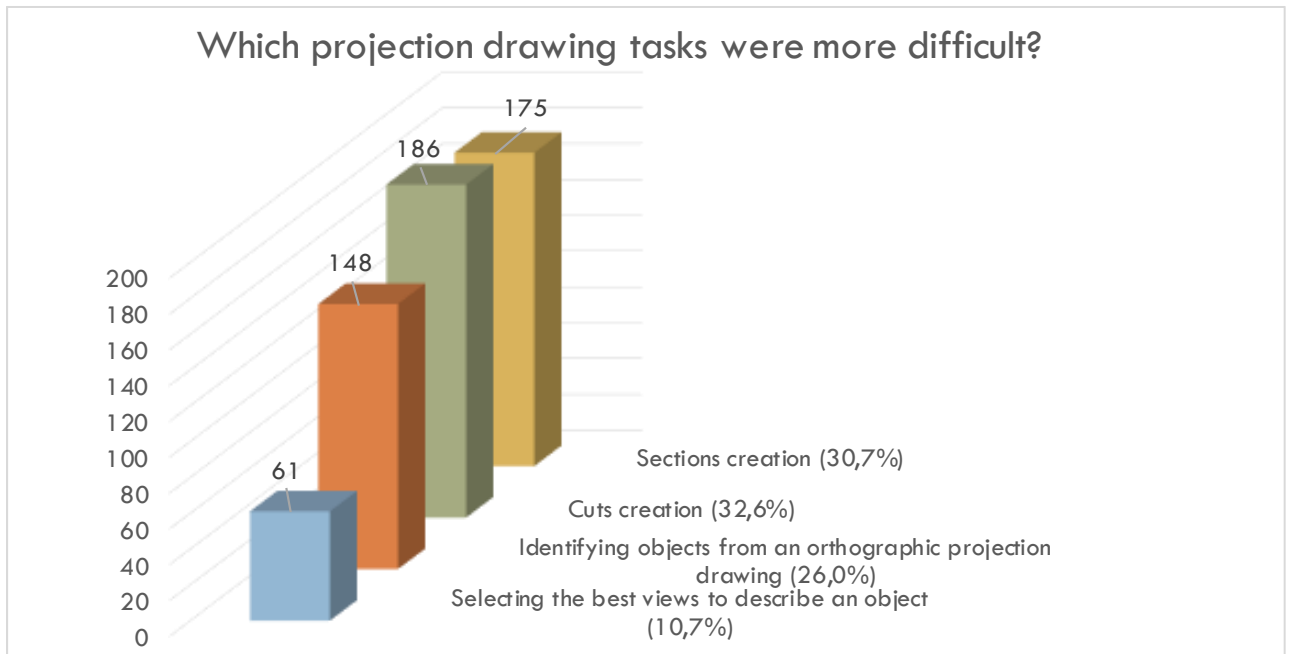
Scales and dimensioning are identified as the more serious issues in drawings shaping:



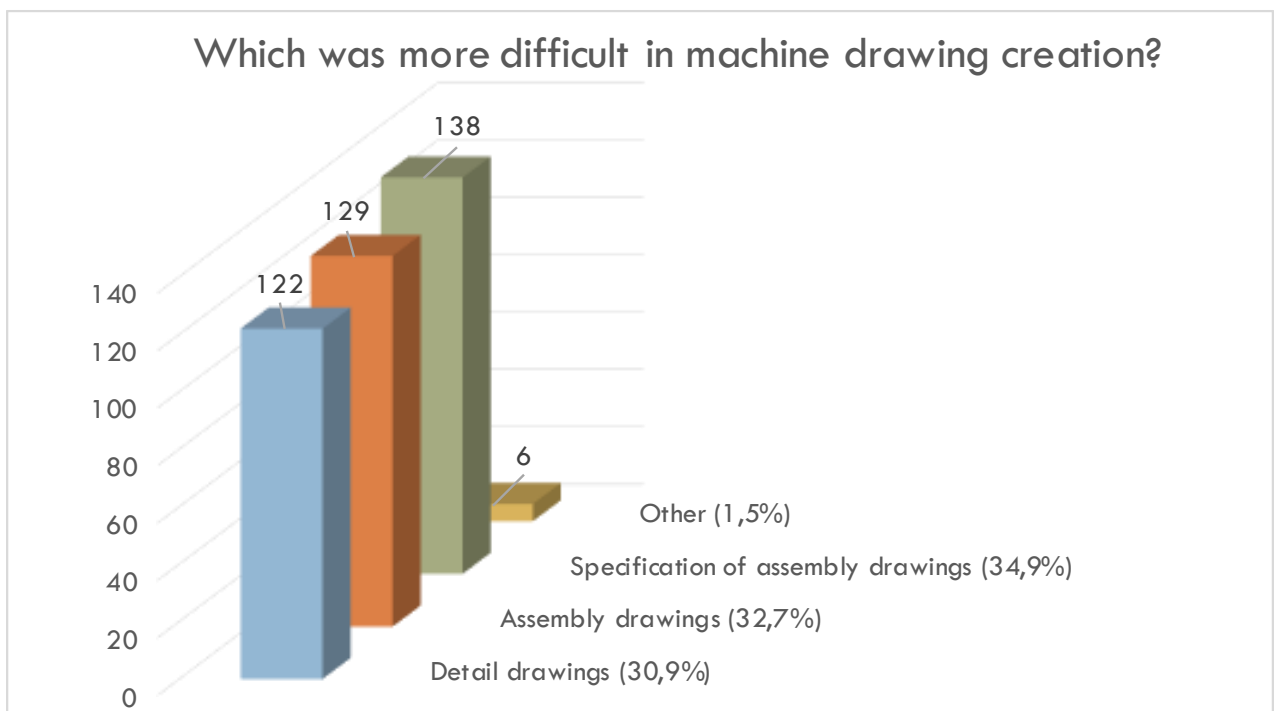
Inscribing any polygon in each circle construction, curves and smooth connections are identified as more difficult to understand in geometrical construction themes:



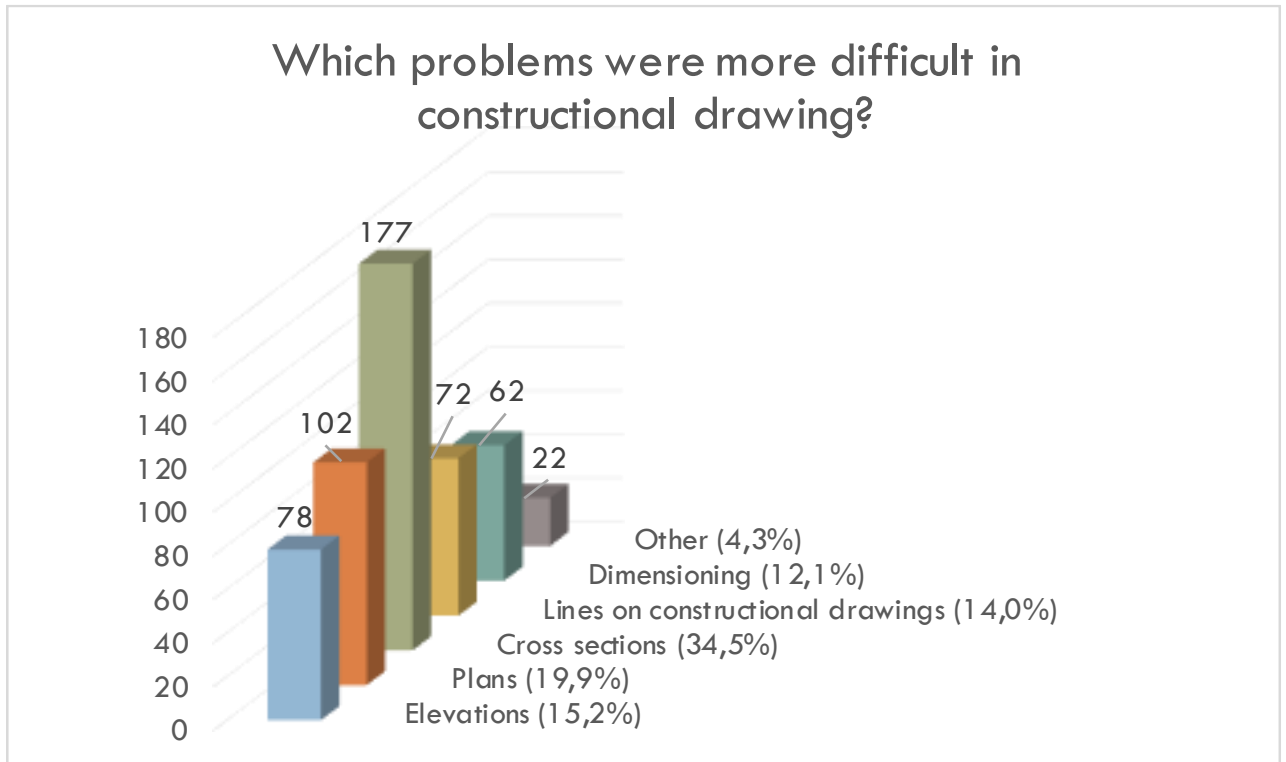
Identifying an object from an orthographic projection drawing, cuts and section creation were most commonly referred to as more complex projection drawing tasks:



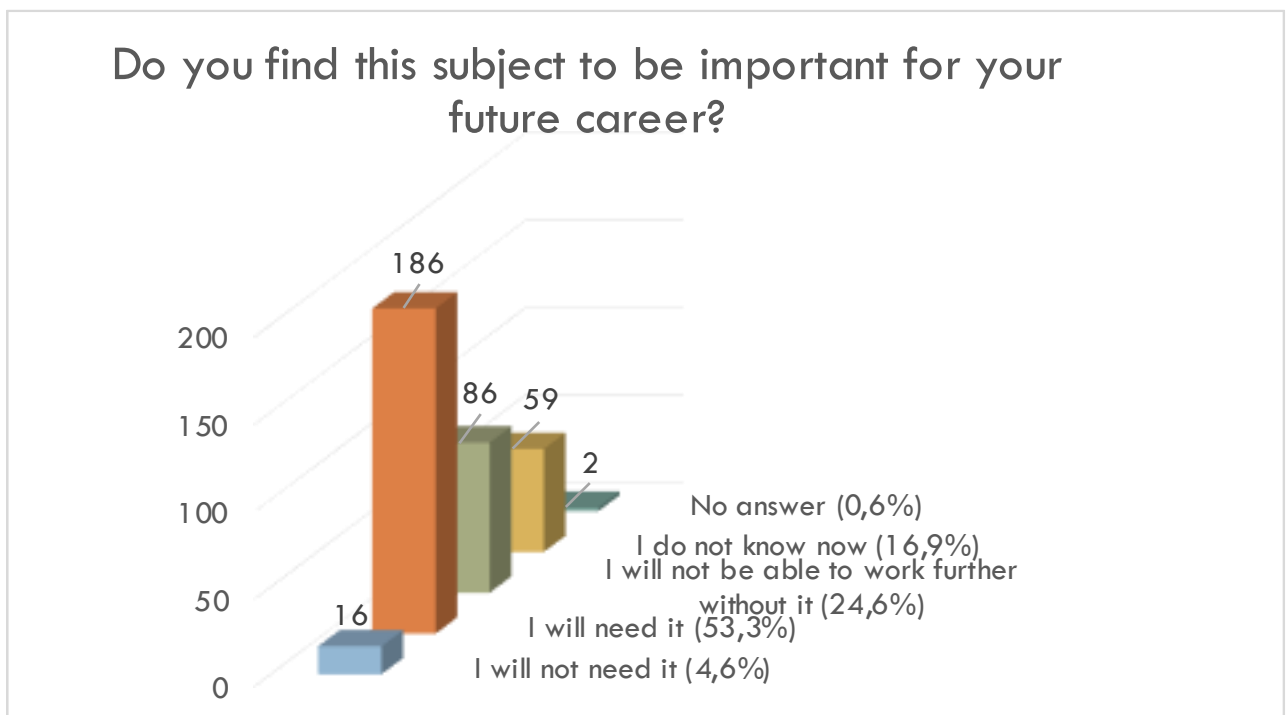
All the themes in the machine drawing were named as equally complex:



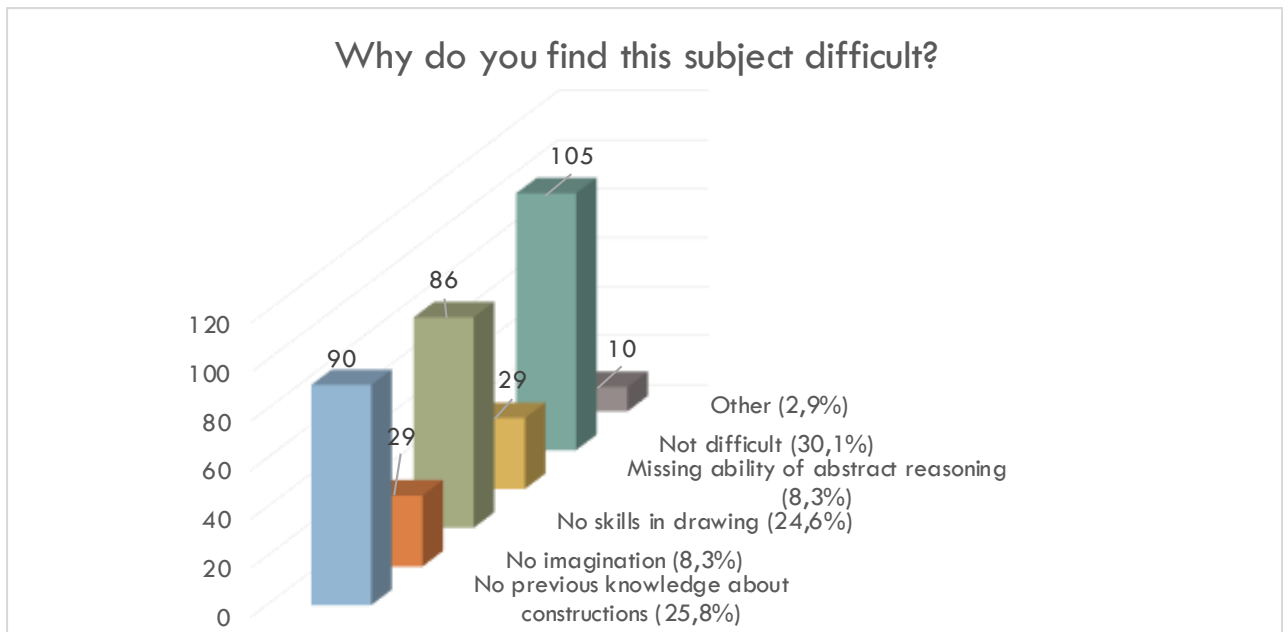
In the constructional drawing section cross-sectional drawing seems as the most complex:



Most students realize that the subject of technical drawing is important for their future career:



The students pointed out a lack of knowledge and skills in drawing as the main reasons why this subject is difficult, but about one third of the students indicated that they were not serious about this subject:



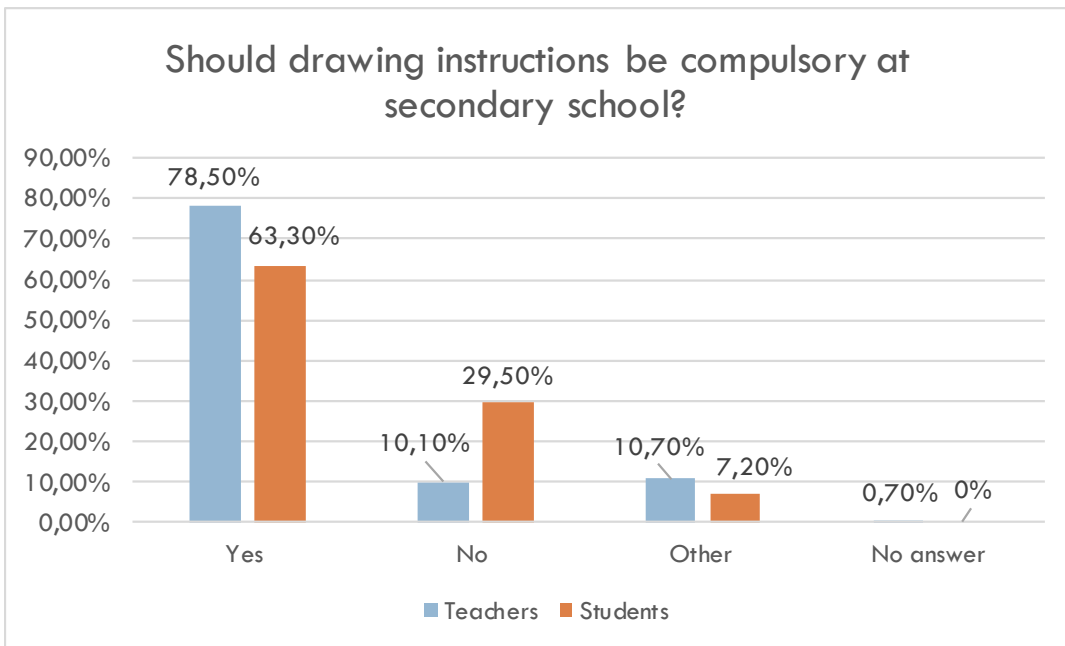
Among the other proposals, the following key ideas could be distinguished for the promoters:

- More lectures and practical work overall.
- Pay more attention to the students, who have never drawn because it is difficult to understand what you require.
- Spend more time to work with the AutoCad program. Pay more attention to turning the drawing on a sheet (AutoCad program).
- Be sure to have a compulsory separate drawing training course. It cannot be integrated into any module. Teaching groups must consist of 12-15 students. There cannot be a big group during drawing practice. The teacher cannot explain it to everyone.

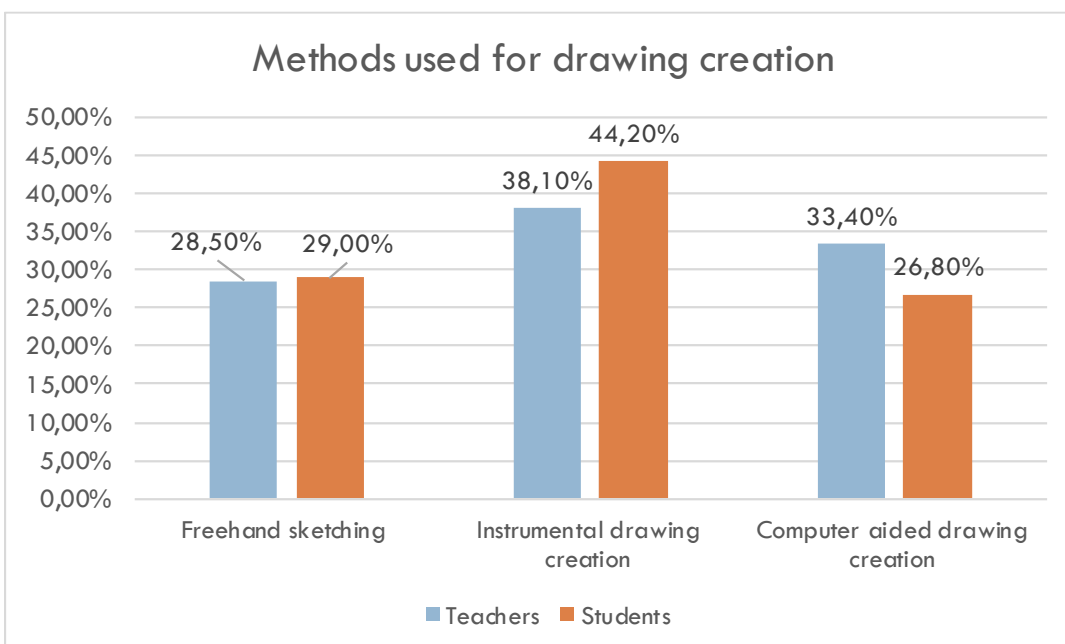
5.3. A comparison

To compare evaluations between teachers and students in a similar way, the questionnaires were presented with several identical questions.

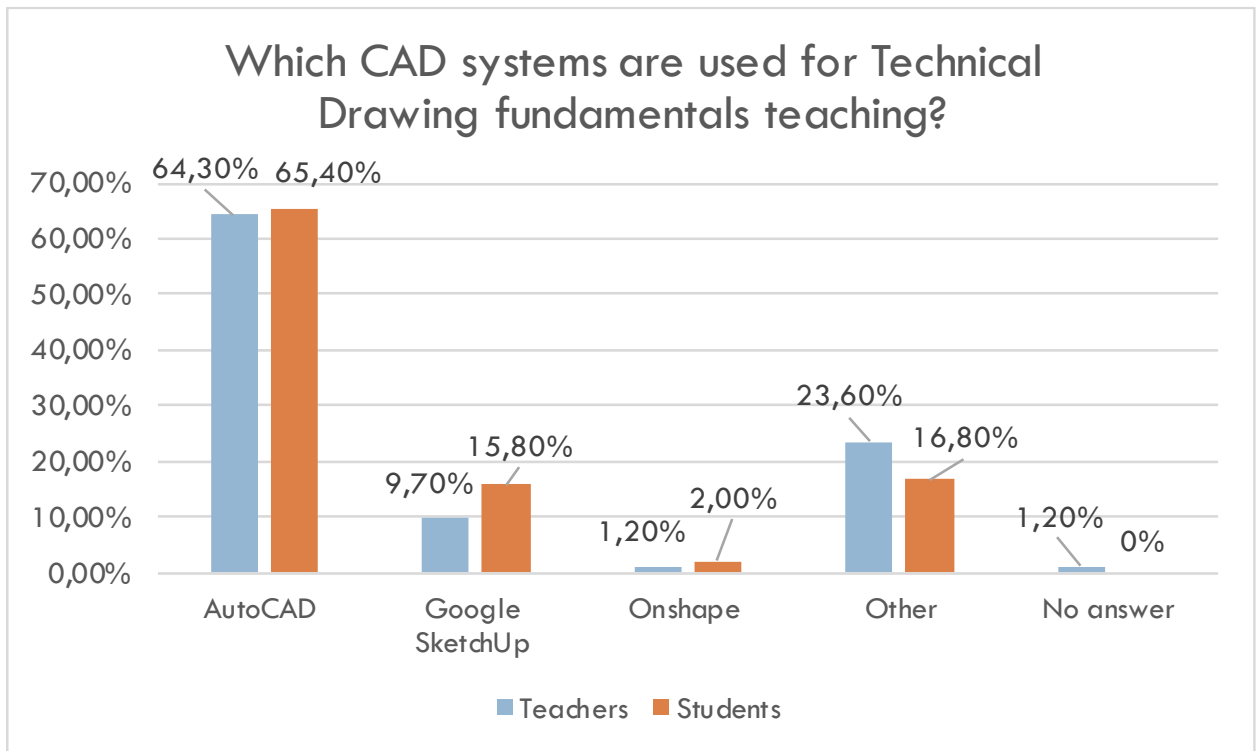
Drawing training in high school as a compulsory subject is often offered by lecturers:



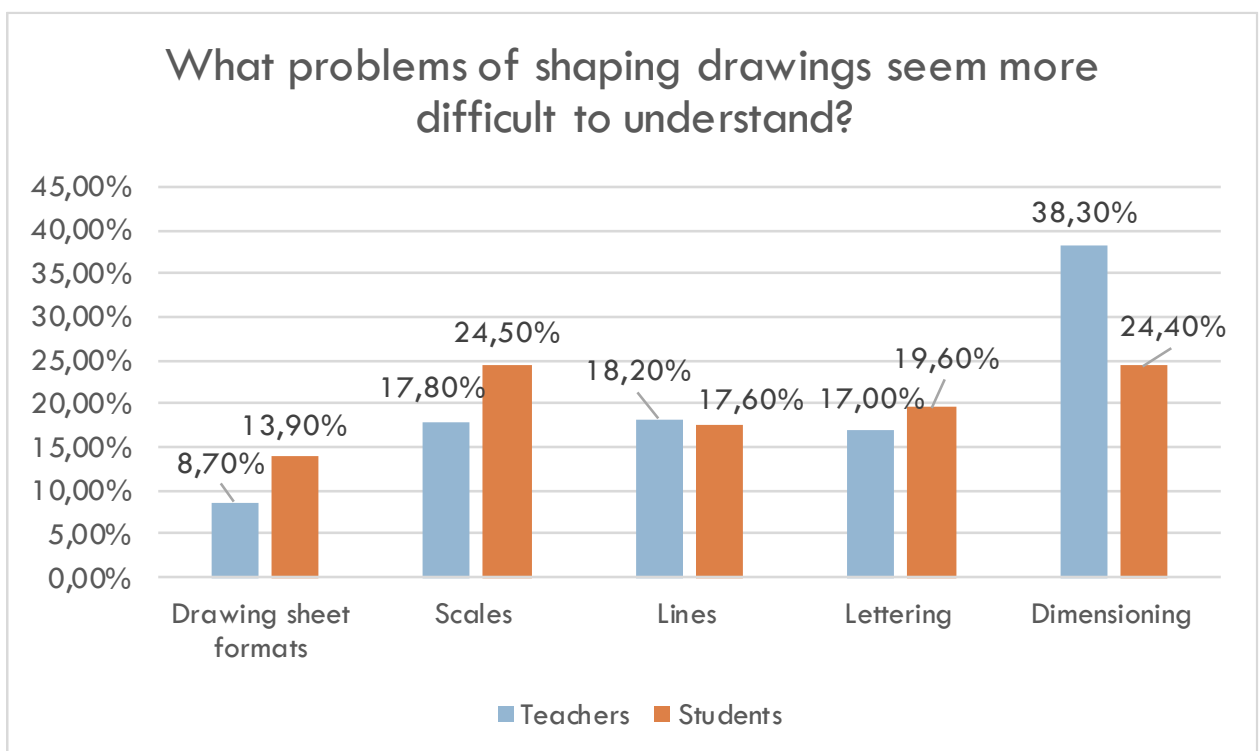
Students are more likely to point out manual instrumental drawing and somewhat less computer aided drawing to address the problem of drawing techniques used in the teaching process:



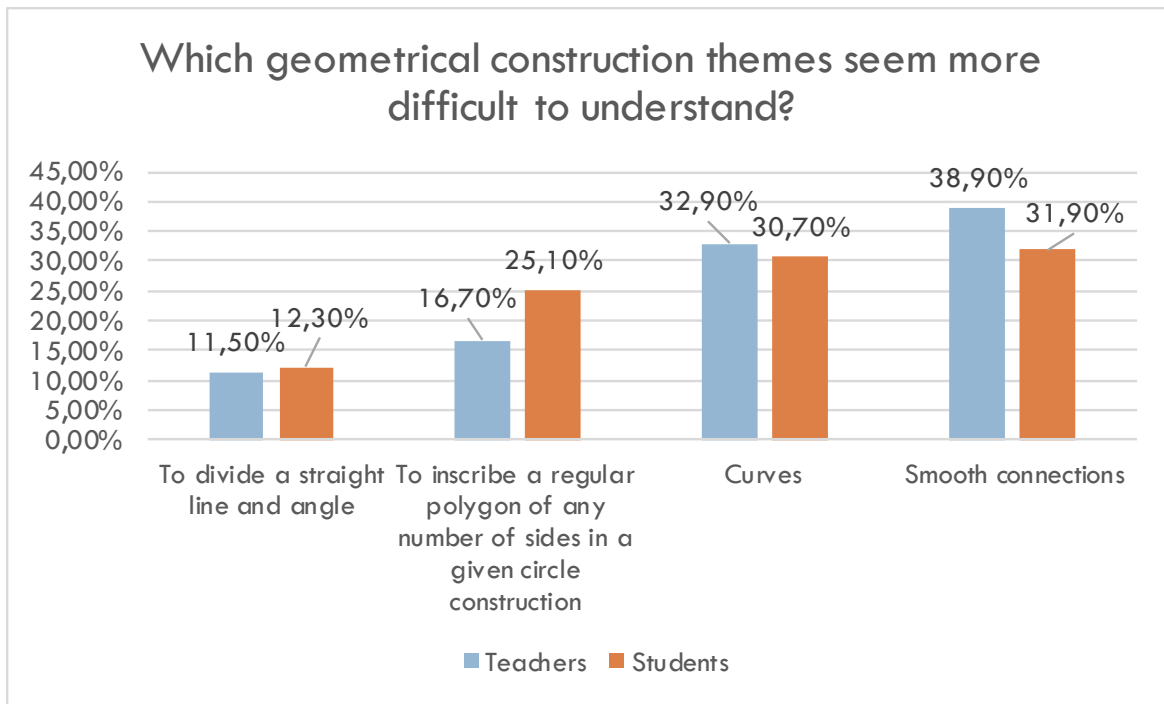
From CAD systems used to teach technical drawing fundamentals, both most often refer to AutoCAD:



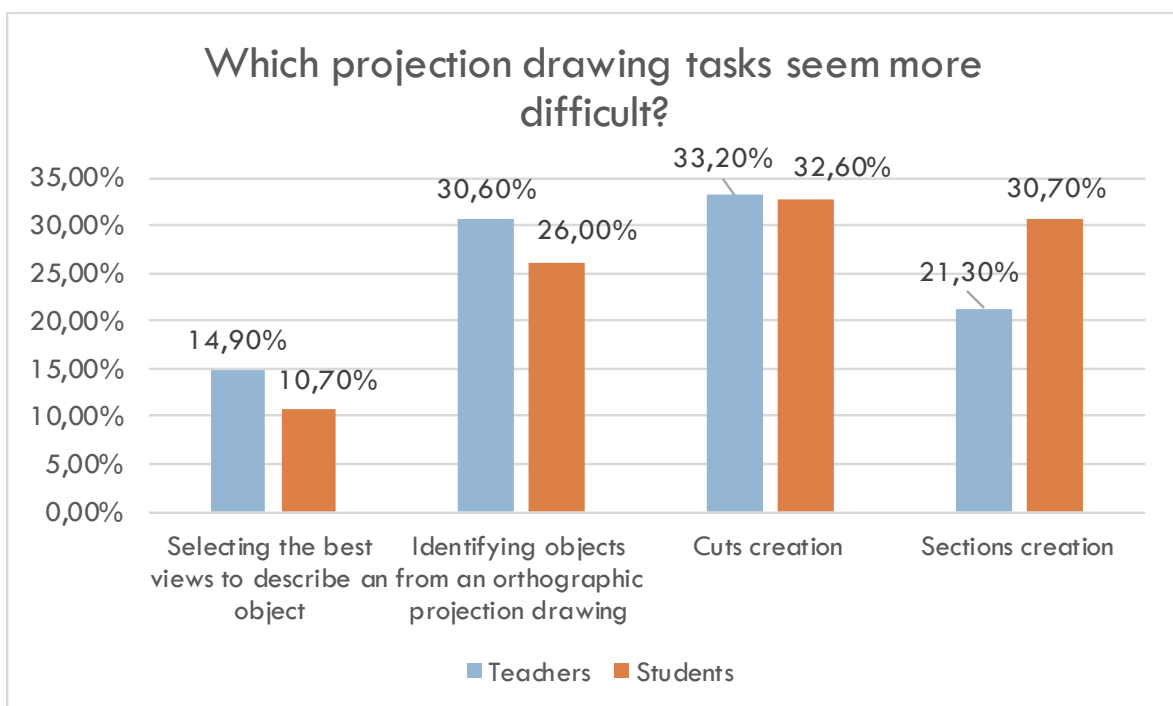
Students can see more difficulties in the drawing sheet format and scales in problems of shaping drawings, and less in dimensioning:



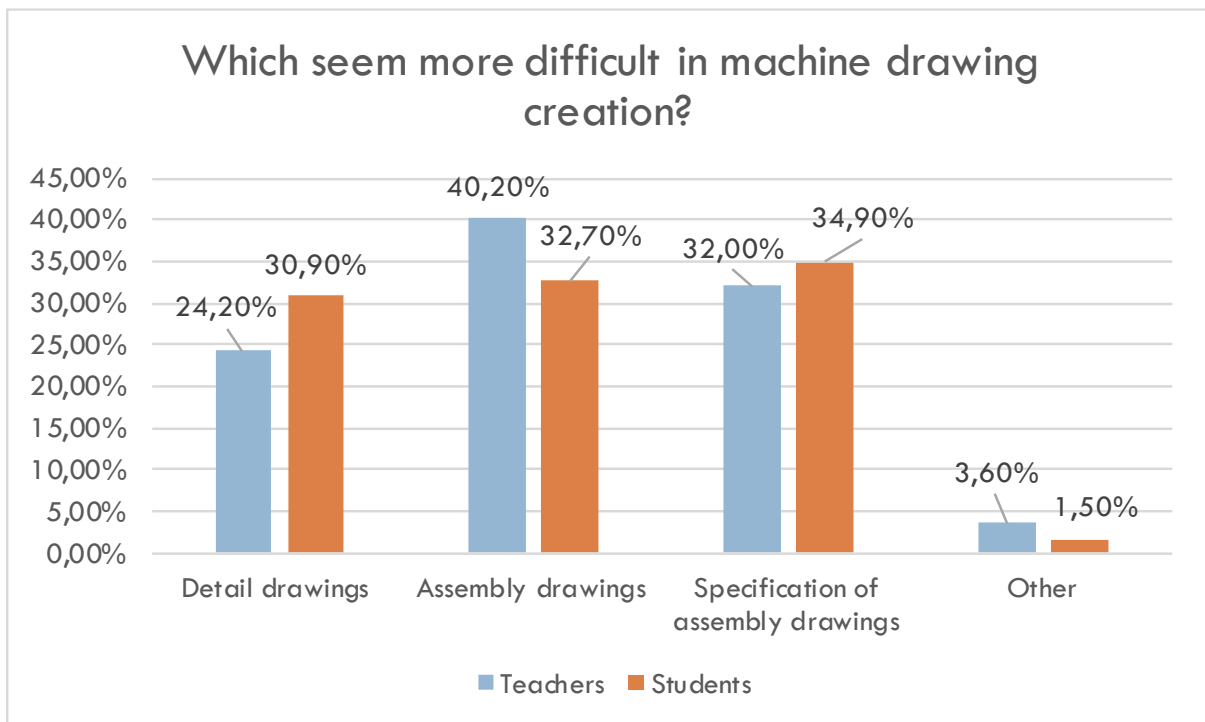
To inscribe a regular polygon of any number of sides in each circle construction for students seems more complicated, and smooth connections is a simpler task in comparison with the opinion of teachers:



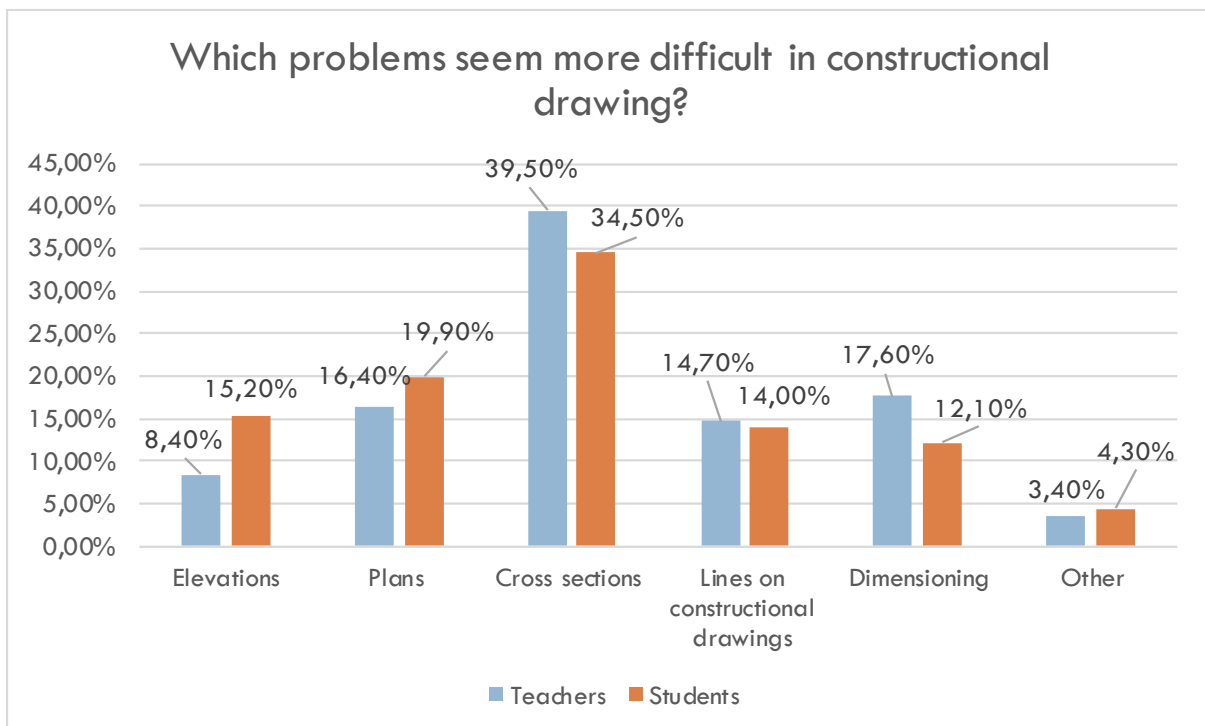
There are minor differences in the responses to the projection drawing tasks. Greater attention should be paid to section creation:



In the machine drawing creation, students find it more difficult to draw detail drawings and fewer assembly drawings compared to teachers' opinion:

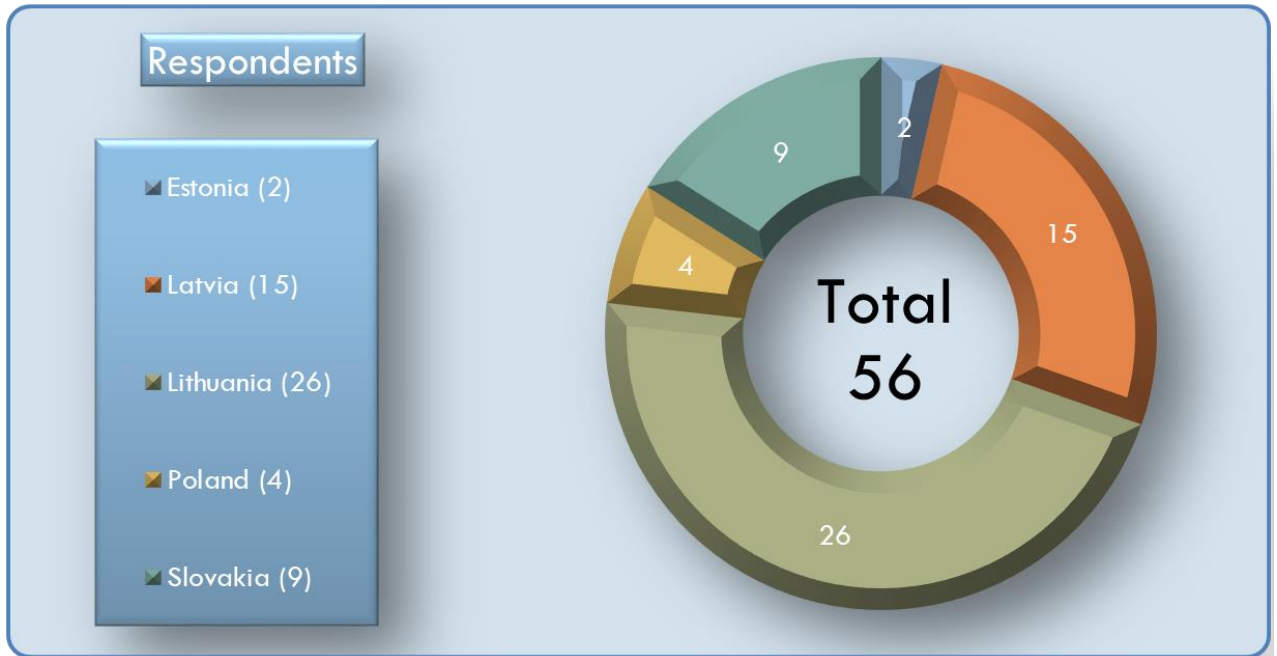


From the tasks of constructional drawings, one needs to pay attention to the elevations drawing task that seems to be more difficult for students:

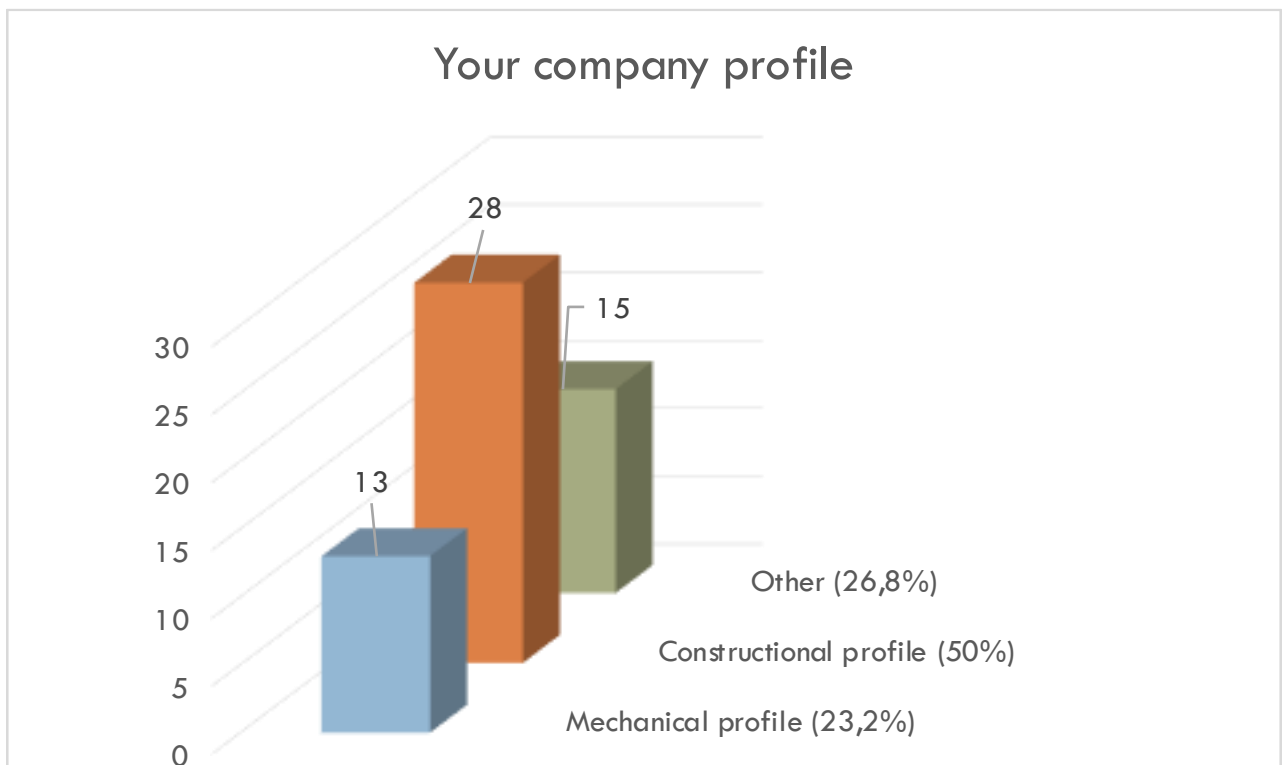


5.4. The importance of Technical Drawing in the labour market

56 questionnaires were received from employers and labor market representatives:

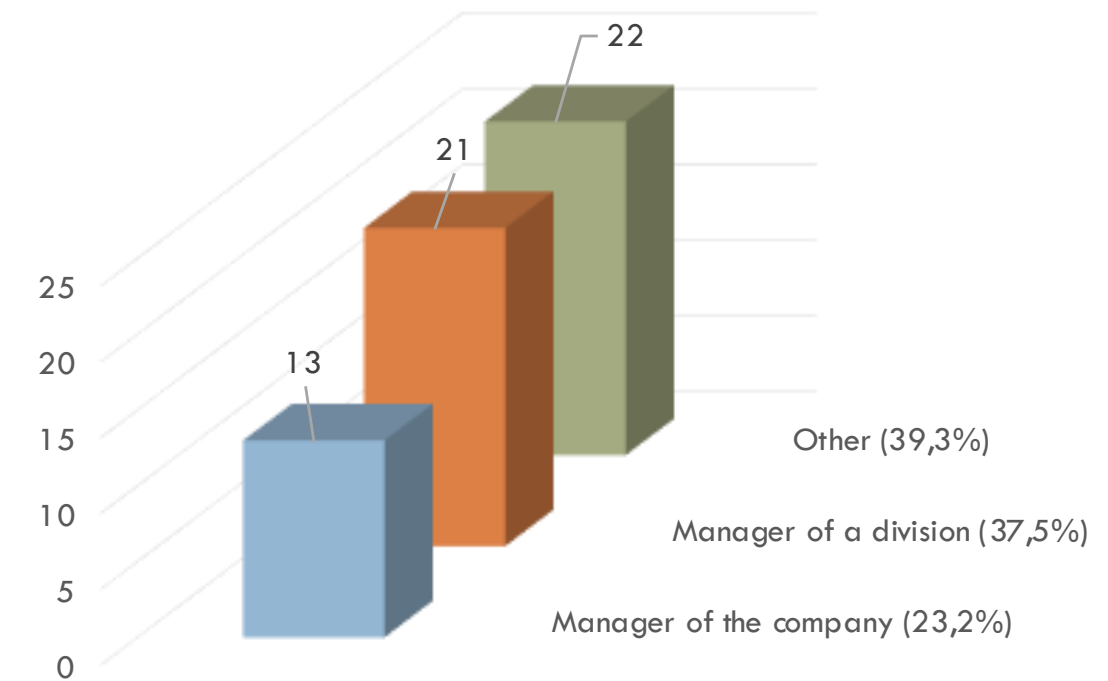


Most of the respondents were from constructional profile companies:

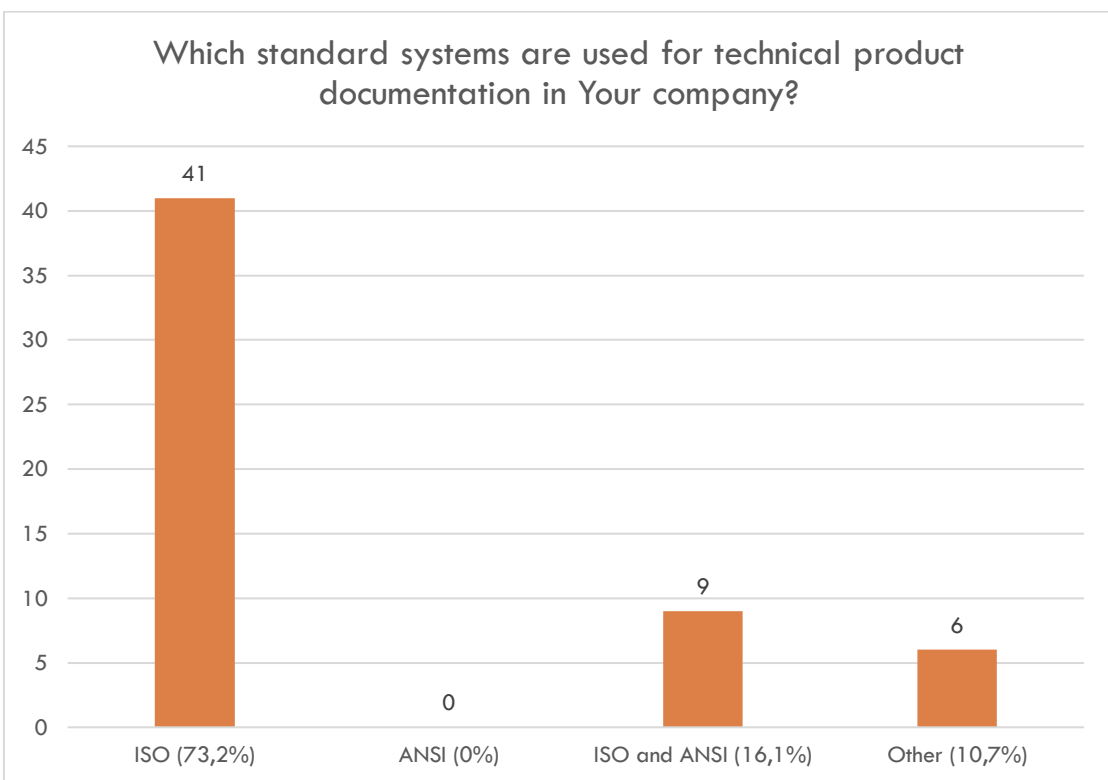


The questionnaires were filled out by various position specialists in the company:

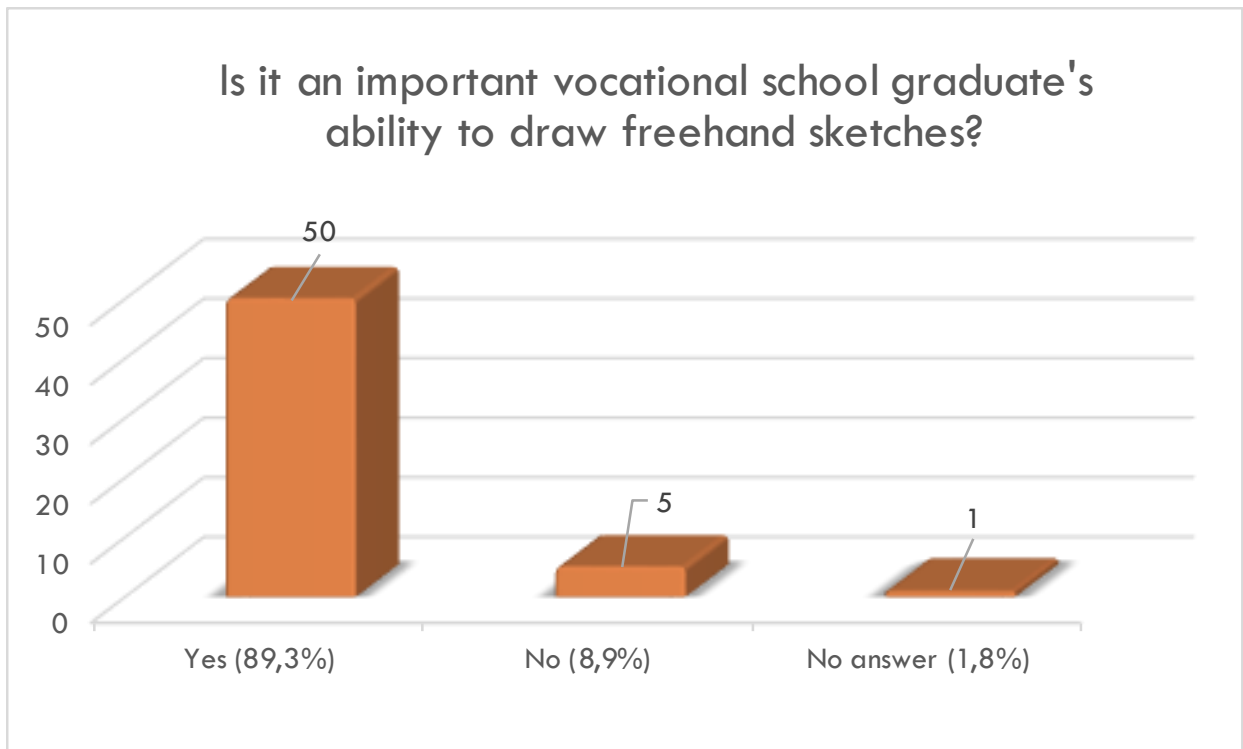
Your position within the company



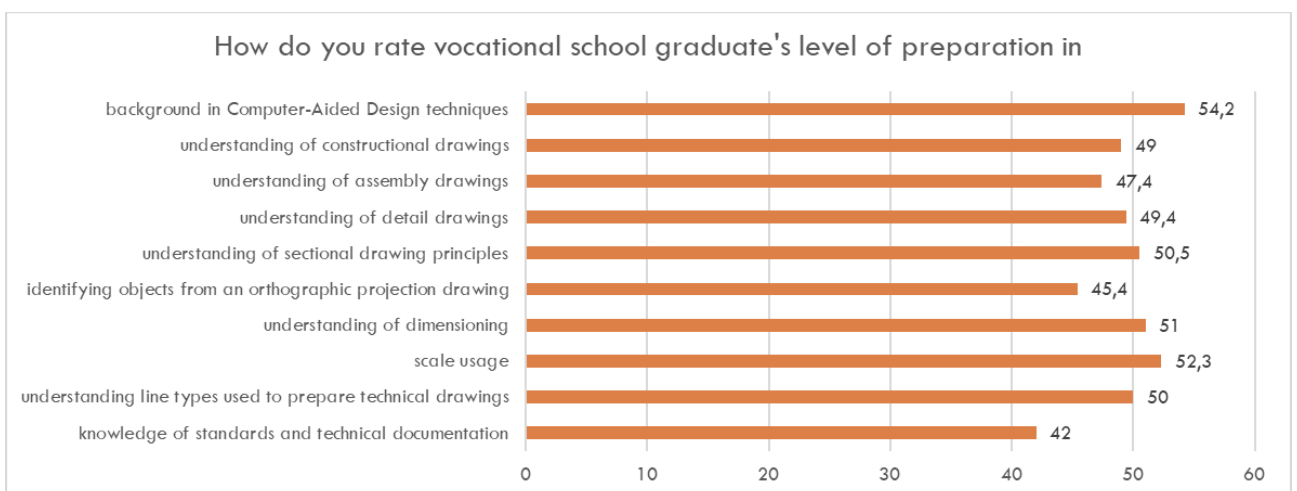
Most companies use the ISO system to handle technical documentation:



Most respondents said that the ability of vocational school graduates to draw sketches is important:



The weighted average level of preparedness for vocational school graduates was assessed on average by many respondents and knowledge of standards and technical documentation and identifying objects from an orthographic projection drawing below average:



Other suggestions include the following:

- More practical abilities.
- Teach students the ability to personalize (customize) the drawing program.

-
- More complex understanding of BIM programs and it's usage (not only CAD).
 - It is important to also provide basic knowledge in the field of production technology, tolerance and fit, roughness, machine construction, which is necessary for correct design and reading of manufacturing crafting specifications of machine parts.

6. Conclusions and recommendations

1. Qualified technical drawing training is important for the labour market.
2. Technical drawing in secondary school must be compulsory.
3. The common qualification requirements of the discipline need to be prepared.
4. More time is needed for lectures and exercises. Teaching groups must consist of 12-15 students.
5. There must be a separate compulsory drawing training course. It cannot be integrated into any module.
6. Assessing the different levels of preparation requires the individualization of the learning content.
7. Educational material should be prepared according to the lean learning principles – to deliver skills and knowledge in short modules which each have very limited objectives.
8. There is a need for a better understanding of standard systems and the management of technical documentation.
9. Freehand sketching is a desirable skill in the job market.
10. Hand-drawn instrumental drawing does not correspond to time-saving, and the application of tests - the principles of creativity.
11. When teaching drawing by using CAD systems, it is necessary to teach not only the drawing rules, but also pay more attention to the issues of personalization of programs, preparation of drawings for printing.
12. When preparing the training material, more attention should be paid to:
 - Scales, lines and dimensioning;
 - Inscribing any polygon in each circle, curves and smooth connections;
 - Identifying objects from an orthographic projection drawing, cuts and sections creation;
 - Detail and assembly drawing creation, specification of assembly drawings;
 - Drawing of elevations, plans and cross sections.

References

1. Evaluation of the survey: Identification of Labour Market Needs for Vocational Education and Training (VET) in the Slovak Republic, (2015) Available at: <https://www.minedu.sk/data/att/8572.pdf>
2. Matuszak M., Waszczuk P., Polish labor market needs in technical professions from employers and teachers point of view, General and Professional Education 3/2012 pp. 7-1. Available at: http://genproedu.com/paper/2012-03/full_007-011.pdf

Appendix 1

Teaching of Technical Drawing

Description

From the 1st of October 2017 an international Erasmus + project has been launched, the main objective of which is to develop interactive and animated teaching materials (computer version) that would facilitate / assist students better learn (master) the technical drawing materials. This project is for professional school students, but its results will be available to university, college students.

The aim of this survey is to study the methodology of teaching the subject matter of the project partner countries (Estonia, Latvia, Lithuania, Poland, Slovakia), the relevance of the teaching chapters, the standards applied, the use of signs and symbols.

1. Gender

- Male
- Female

2. Should compulsory drawing instruction be in high school?

- Yes
- No
-

3. You teach the Technical Drawing course

- in vocational school
- in college
- at university
-

4. Your specialty

- mechanical profile
- constructional profile
-

5. How many learners it is in the group during practical work?

- 10 - 15

16 - 20

21 - 25

26 - 30

6. What methods for drawing creation you are used for teaching?

Freehand sketching

Instrumental drawing creation

Computer aided drawing creation

7. What CAD systems are used for Technical Drawing fundamentals teaching?

AutoCAD

Google SketchUp

Onshape

8. What problems of drawings shaping are more difficult for students to understand?

Drawing sheet formats

Scales

Lines

Lettering

Dimensioning

9. What geometrical construction themes are for students more difficult to understand?

To divide a straight line and angle

To inscribe a regular polygon of any number of sides in each circle construction

Curves

Smooth connections

10. Whose projection drawing tasks for students are more complex?

Selecting the best views to describe an object

Identifying objects from an orthographic projection drawing

Cuts creation

Sections creation

11. What is more difficult for students in machines drawing creation?

Detail drawings

Assembly drawings

Specification of assembly drawings

12. What problems in constructional drawing for students is more complex?

Elevations

Plans

Cross sections

Lines on constructional drawings

Dimensioning

13. Which difficulties do you meet at your work?

Lack of methodical devices

Shortage of work stations in computer classes

Large number of students in the class

No previous knowledge

Indisposition to learn

14. What kind of active learning methods do you apply in the educational process?

Special computer programs

Distance learning tools

Teamwork application

Test application

Defending works

15. What students' skills consider the most important for their future careers?

- The ability to accurately reproduce information
- Ability to work in a team
- Self-sufficiency
- Creativity
- The use of computer programs
-

16. What other suggestions that did not reflect on the questions you can propose to the project development (teaching methodology, time spent on learning this subject, etc.)?



Appendix 2

Learning of Technical Drawing

Description

From the 1st of October 2017 an international Erasmus + project has been launched, the main objective of which is to develop interactive and animated teaching materials (computer version) that would facilitate / assist students better learn (master) the technical drawing materials. This project is for professional school students, but its results will be available to university, college students.

The aim of this survey is to study the methodology of teaching the subject matter of the project partner countries (Estonia, Latvia, Lithuania, Poland, Slovakia), the relevance of the teaching chapters, the standards applied, the use of signs and symbols.

1. Gender

- Male
- Female

2. At secondary school I learned Technical Drawing

- as a compulsory subject
- as an elective subject
- independently
- I didn't study it

3. Should drawing instructions be compulsory at secondary school?

- Yes
- No
-

4. I studied the Technical Drawing course

- in vocational school
- in college
- at university
-

5. Your specialty

- Mechanical profile
- Constructional profile
-

6. How many students were in the group during practical work?

- 10 - 15
- 16 - 20
- 21 - 25
- 26 - 30
-

7. What methods were used for drawing creation?

- Freehand sketching
- Instrumental drawing creation
- Computer aided drawing creation

8. Which CAD systems were used for teaching the fundamentals of Technical Drawing?

- AutoCAD
- Google SkechUp
- Onshape
-

9. What problems of shaping drawings were more difficult to understand?

- Drawing sheet formats
- Scales
- Lines
- Lettering
- Dimensioning

10. Which geometrical construction themes were more difficult to understand?

- Dividing a straight line and angle

Inscribing any polygon in a given circle

Curves

Smooth connections

11. Which projection drawing tasks were more difficult?

Selecting the best views to describe an object

Identifying objects from an orthographic projection drawing

Creating cuts

Creating sections

12. Which was more difficult in machine drawing creation?

Detailed drawings

Assembly drawings

Specification of assembly drawings

13. Which problems were more difficult in constructional drawing?

Elevations

Plans

Cross sections

Lines on constructional drawings

Dimensioning

14. Do you find this subject to be important for your future career?

I will not need it

I will need it

I will not be able to work further without it

I do not know now

15. Why do you find this subject difficult?

-
- No previous knowledge about constructions
 - No imagination
 - No skills in drawing
 - Missing ability of abstract reasoning
 - Not difficult
 -

16. What other suggestions that did not reflect on the questions can you propose for the project development (teaching methodology, time spent on learning this subject, etc.)?



Appendix 3

Importance of Technical Drawing in the labour market

Description

From the 1st of October 2017 an international Erasmus + project has been launched, the main objective of which is to develop interactive and animated teaching materials (computer version) that would facilitate / assist students better learn (master) the technical drawing materials. This project is for professional school students, but its results will be available to university, college students.

The aim of this survey is to study the methodology of teaching the subject matter of the project partner countries (Estonia, Latvia, Lithuania, Poland, Slovakia), the relevance of the teaching chapters, the standards applied, the use of signs and symbols.

1. Your company profile

- Mechanical
- Constructional
-

2. Your position within the company

- Manager of the company
- Manager of a division
-

3. Which standard systems are used for technical product documentation in Your company?

- ISO
- ANSI
- ISO and ANSI
-

4. Which CAD systems in Your company are used?



5. Is it an important vocational school graduate's ability to draw freehand sketches?

Yes

No

6. How do you rate vocational school graduate's level of preparation in

knowledge of standards and technical documentation

understanding line types used to prepare technical drawings

scale usage

understanding of dimensioning

identifying objects from an orthographic projection drawing

understanding of sectional drawing principles

understanding of detail drawings

understanding of assembly drawings

understanding of constructional drawings

background in Computer-Aided Design techniques

7. What other suggestions that did not reflect on the questions you can propose to the project development (the qualities that employers seek and alike)?

