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Mechanical Engineering Students at Dalian Jiaotong University Should Keep Learning Hand-drawing Courses

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Abstract: *With the development of electronic information, digital drawing like Solidworks has become an increasingly large part of the mechanical field. Also, followed by the development of technology, mechanical engineering students need to engage in more courses. This has led to a discussion about the need for mechanical engineering students to continue learn hand-drawing courses. This paper takes mechanical engineering students at Dalian Jiaotong University as the subject of the study. This paper argues that mechanical engineering students at Dalian Jiaotong University should continue to take hand-drawing courses by introducing that digital drafting is just a tool, and using this tool requires spatial imagination, which can be developed by hand-drawing courses. This paper also verify the conclusion by experimental data, and show that there will be serious consequences if mechanical engineering students do not take hand-drawing courses. To sum up, mechanical engineering students at Dalian Jiaotong University should keep learning Hand-drawing courses.*

Keywords: *Hand-drawing courses, Digital drawing, Mechanical engineering*

1. Introduction

Some think mechanical engineering students at Dalian Jiaotong University (DJTU ME students) do not need hand-drawing courses in their already tight schedules because digital drawing has matured.

2. Background Information

Digital drawing is, in fact, quite mature. The continuous development of CAD software technology in recent years has increase many functions. This has led many mechanical engineering designers to introduce CAD software like Solidworks into their daily engineering design and drawing process, which not only effectively improves efficiency of drawing, but also ensured the accuracy of the drawings. This phenomenon proving that digital drawing software has spread widely into mechanical fields. [1]

Table 1: Mechanical Engineering required courses for DJTU ME students [3] [4]

Year	Required courses	Total
1998	Mechanical principles	4
	Metal Technology	
	Mechanical design	
	Metal Materials and Heat Treatment	
2019	Fundamentals of machine building technology	6
	Mechanical principles	
	Fundamentals of Interchangeability and Measurement Technology	
	Facility Planning and System Simulation	
	Hydraulic and pneumatic transmission	
	Fundamentals of engineering materials and material forming technology processes	

Note: The above table only include the professional graduation courses, excluding the professional foundation courses that support the professional graduation courses.

Simultaneously, as new technologies such as digital drawing matured, to adapt to technological advances, DJTU ME students take more courses than before. Professor Lihua, who worked as a professor of mechanical engineering at DJTU, taking DJTU as an example, she pointed out the school opens many

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courses for engineering students to adapt construction of new engineering education [2]. Also in the DJTU undergraduate teaching website, we found many changes in the required courses for mechanical engineering majors between 1988 and 2019, and the changes are shown in Table 1.

As we can see from the table, the number of courses for DJTU ME students has become greater, the fields covered have become more varied, and the research is more in-depth. However, students have limited time to learn, which leads to the trade-off problems of hand-drawing courses.

Despite the popularity of digital drawing and students' tense course problems, we still believe that DJTU ME students should not give up hand-drawing courses for three reasons.

3. Arguments

To begin with, digital drawing is just a tool. This tool is mainly used for the electronic three-dimensional representation of objects. Professor Susan Valerie McLaren, who belongs to the University of Strathclyde, deems that digital drawing is a tool that conveys engineers' ideas, if engineers have no "ideas", this tool is useless [5]. According to Wikipedia [6], using the tool requires a specific ability. As the professor said, using digital drawing software requires one's ideas, and such ideas are the ability to use digital drawing. Therefore, digital drawing is just a tool.

The second point is that engineers need spatial imagination to use digital drawing tools well. Take an example of drawing a 4mm cap screw like Figure 1. Firstly, objects are decomposed from a three-dimensional (3D) graph into Cartesian coordinates in the x, y, and z directions, as seen in Figure 1. a and.b. Then appropriate materials are chosen to generate it like Figure 1. c. However, users may encounter mistakes requiring them to check the three-dimension drawing, like Figure 1. d. The use of spatial imagination throughout the operation is reflected in the user's ability to imagine the shape and internal structure of the model. Therefore, Spatial imagination is the abstract thinking ability of people to observe, analyze and cognize the spatial form of objective things. Spatial imagination can bring the principle of an object's structure and give ideas to generate the object. This ability can generate ideas for engineers to use digital drawing well [5]. In conclusion, spatial imagination is needed for digital drawing.

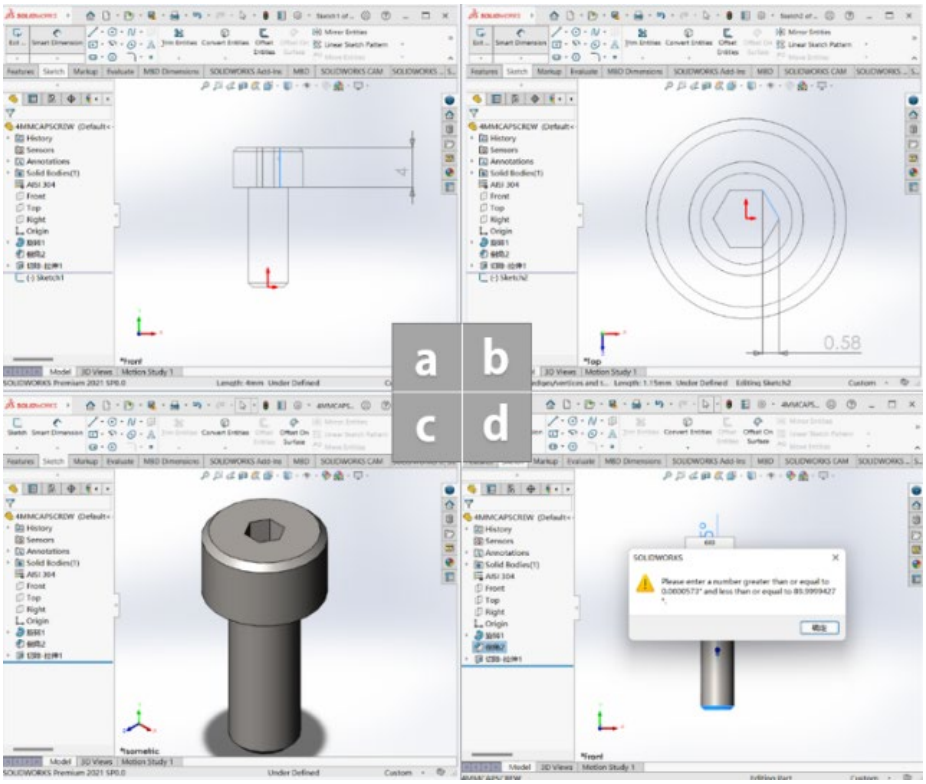

Figure 1: Screenshot of Solidworks

The third point is that hand-drawing courses can develop spatial imagination. DJTU hand-drawing courses' main content is to draw 3-D graphs of the classic models like the combination of columns, spheres, and prisms. [7] As figure 2 shows, students analyze the model structure to express it through

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three views. The process of analyzing the model is to dissect the model, understand the internal and external system, and determine the corresponding situation of each edge of the model. Through such practice, students' ability to analyze abstract problems can be enhanced, so this process is an excellent way to develop students' spatial imagination. Therefore, hand-drawing courses can develop students' spatial imagination.

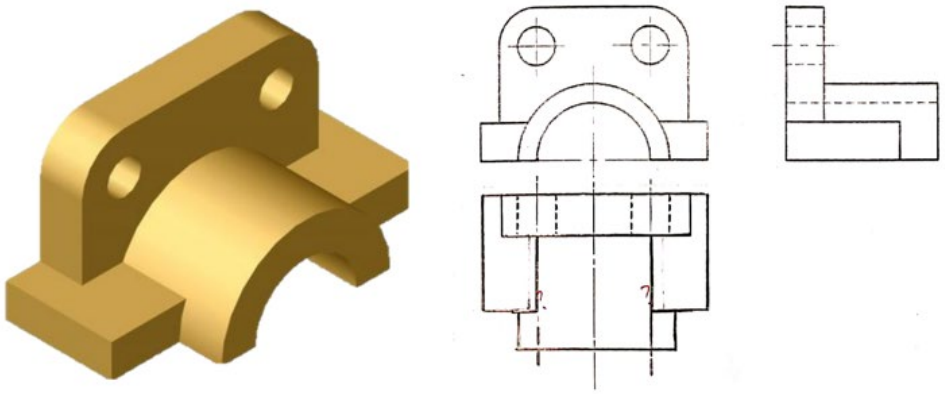

Figure 2: Model and student's work

4. Counterargument and rebuttal

Hand-drawing courses develop spatial abilities that engineers need to use in digital drawing. However, some still argue that DJTU ME students can save time by studying hand-drawing on their own.

The behavior of students' self-study of hand drawing courses is short-sighted. The hand drawing course is practical. DJTU's hand-drawing courses provide more practical parts than theory courses. Professor Xie Jun, School of Mechanical Engineering, Dalian Jiaotong University, said: "The essential feature of hand-drawing courses is to practice, making mistakes and correct by following the teacher's advice" [8]. We can also gain conclusion from her course arrangement. Taking an example of professor Xiejun's hand-drawing courses for ME201 in 2021, we summary her teaching arrangement as table 2 shows.

Table 2: Composition of basic cartographic grades [9]

Mode Description	Appraisal Method			
	Drawing practice	quiz	Combination design	Course Self-check
Percentage of total score	50%	20%	20%	10%
Working method	Personal or team	Personal	Team	Personal
Forms of results	Drawing or video	Drawing	Drawing and presentation	Drawing and video

Note: The above table is only focus on Mechanical Engineering 2020 students.

From Table 2, it can be seen that the assessment form of Professor Xie Jun's hand-drawing course is different from the traditional university course, which is for regular grades and final theoretical grades, while Professor Xie Jun's course is all in the form of practice, and there is no assessment about hand-drawing theory. This indicates that the theory of the drafting course is only the foundation, and the students' task is to apply the theory to practice.

But then there are those who say that we can complete the course by self-study, learning the theory ourselves and then doing the practical training ourselves. In our opinion, practice is necessary, but self-study is challenging to achieve this goal. Chen jingcai, an education professor at Peking University, said that nearly 75% of self-study people in Chinese universities take the theory seriously, ignoring practical application [9]. Similarly, DJTU ME students may lose many practices by self-study [10], in turn, lack spatial imagination, causing them to encounter many fundamental problems that originally should be practiced in hand-drawing courses, such as being puzzled by an object's complex 3-D draft during using digital drawing. In this case, students will waste more time learning it. Also, to accelerate the training of high-quality engineers and technicians, cultivate students' craftsmanship, and test their drafting skills, DJTU had organized the 2021 Solidworks competition, this match was divided into major teams who had received hand-drawing courses from DJTU and non-major teams that relied on the self-learning, as

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Figure 3 shows, the major team occupied on high segments, while non-major team occupied on low segments. The higher the score, the higher the comprehensive level of drawing [11]. This indicates that students who had received hand-drawing courses were better at drawing than self-taught students. To sum up, a hand-drawing course is a practical course that students must attend to practice instead of only studying the theory by themselves [12].

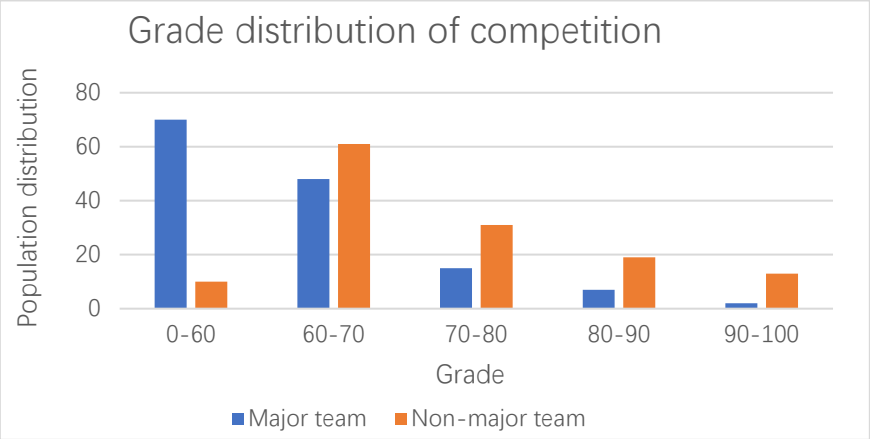

Figure 3: 2021 DJTU Solidworks grade distribution

5. Conclusion

Mechanical engineering students at Dalian Jiaotong University should keep learning hand-drawing courses. If students skip hand-drawing procedures, then fewer DJTU ME student can to use digital drawing efficiently. This will lead to a decline in the quality of graduates, causing the reputation of DJTU to go down. This could lead to the mechanical industry losing skilled workers and destroying the mechanical sector, eventually causing the collapse of social operations. Therefore, Mechanical engineering students at Dalian Jiaotong University should keep learning hand-drawing courses.

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