

# DOES ONLINE DIDACTICS AFFECT THE PERCEIVED QUALITY OF MACHINE DRAWING COURSES?

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## ABSTRACT

Considering reviewers' opinions on the paper, presented at EPDE2021, in which the data were not sufficient to compare different cohorts, now we are able to answer if there have been differences in students' assessments, based on some questions of the academic survey on didactics, comparing answers for courses held pre-and-during Covid19 pandemic.

In 2020 every educational institution moved their didactics toward an online platform.

Every course had to introduce and experiment with new forms of didactics that prevent in-person events, either in lectures or laboratory.

Courses of design traditionally require a strict relation between student-instructor and student-student.

The need to operate by moving the contact to an online connection creates, at the beginning of the period, a lot of distrust among teachers of such courses. The “Machine Drawing” course is one of these.

Briefly recalling how the courses have been revised, with the employment of a communication platform like Teams®, the answers, given by students, are collected and the differences along the time are highlighted. Three academic years have been considered: 2017-2018, 2019-2020, and 2020-2021.

A further correlation has been made considering different didactics and the global efficiency of the course in terms of abandonment, number of successes (number of people that pass the exam), and the effects on the grades (marks) obtained.

Reflecting on such data, a new consideration has been done on the methodologies that can still continue to be used in the future when the explicit problem of pandemic emergency does will not influence anymore the traditional way of teaching.

*Keywords: Online didactics, students' assessments, teaching quality improvement*

## 1 INTRODUCTION

Covid-19 pandemic during the years 2020 and 2021 pushed educational institutions to move several activities performed in-person, as traditionally have been done and will continue to be done in the future, towards the systematic employment of online supports [1], [2]. During this time, which involved in Italy three semesters, from March 2020 till June 2021, new experimentations have been proved in all kinds of subjects.

Really since 2000 many experiments have been proposed for teaching supported by LMS (Learning Management Systems) for Online Distance Learning (ODL). These kinds of tools require a lot of time for their design and implementation and teachers should be skilled in their usage. Only those Institutions that invested in these tools were able to migrate all their teaching towards online with few tuning [3]. More generally, technology-enhanced learning and teaching have been explored in some detail, to identify which specific aspects have been or can be enhanced in higher education by not traditional means. [4]

Starting quarantine orders, all the other teachers worldwide in a lapse of a few weeks organized their teaching by means of video-conferencing/meeting software, such as Teams®, made available to all attendees.

All teachers had to face their ability to teach in-person in the employment of such new methodologies, even though it must be considered that not all subjects can be validly supported by them. And not all teachers dealt with the emergency effectively [5].

At the same time, some studies were undertaken to analyse how much the quality of online education, in its various forms (hybrid, blended, etc.) is perceived by students, both in terms of content and the role of teachers [6].

In any case, designing online courses is not a trivial activity [7], and can lead to success in an increasingly global and distributed education market [8].

Machine Drawing is a topic quite complex because interests a lot of competencies and skilfulness, cognitive attitudes, and ability of synthesis necessary for students for using the language of drawing to communicate design intent to all stakeholders of the design process [9].

The laboratory is an activity of basic importance in such kind of course because the topics heard in the lesson must be put into action in drawings that depict in the right way the geometry and the form of a 3D part or assembly and that integrate all the symbols introduced by rules and standards to clarify many other elements, such as manufacturability, measurements, tolerances, necessary to guarantee that what has been drawn can be produced.

The history of the evolution that this course underwent during the pandemic emergency highlighted how, despite an initial phase of scepticism, new opportunities have emerged for the aspects of coaching, mentoring, and tutoring, in order to create the conditions for students' mechanical engineering skills to emerge and begin to form.

The paper is focused on analysing three academic years in which the course of Machine Drawings for Mechanical Engineering degree was delivered in different ways, comparing the answers that students gave to the surveys for didactic assessments and some of their performances in examinations.

## **2 COMPARISONS BETWEEN THE METHODS OF DELIVERING THE COURSE**

The three academic years examined have been 2017/18, 2019/20, and 2020/21. The first one 2017/18 was carried out in-person; in the year 2019/20 the first semester was in-person and the second online; the year 2020/21 was carried out completely online.

Till the first semester of 2019/20, the didactic in-person was followed by the same scheme: the laboratory was supported by professionals and/or junior lecturers that aided students in the development of drawings and projects with increasing difficulty, interacting with them during the time weekly scheduled for this.

Every year a set of homework is assigned to students, that must be completed validly in order to have access to the exam. Weekly in the timetable, two hours are assigned to laboratory in which all the questions related to the homework are discussed. During the in-person modality, students arrived in the classroom with the materials on which they were working and discuss with instructors the difficulties encountered, then they gained the OK about the correctness of graphical representations.

The second semester of 2019/20 was really stressful and tiring for all, students and teachers. During the course, and the laboratory overall, a lot of time was spent supporting students individually or in groups to discuss and correct all kinds of mistakes done in the drawings. This introduced the question to share the homework online. Drawings in fact were exchanged by Teams or email as jpeg images or pdf files. Interesting was the first usage of online tutoring with video conferencing and live corrections on drawings by means of a pen tablet and graphic tools such as SketchBook®. Also, during this semester, laboratory was supported by professionals and junior lecturers.

During 2020/21 the course was completely delivered online. A second event was the difficulty in recruiting professionals for laboratory activities. This pushed the teacher to give all activities of the course (lectures, laboratory) alone. This was not heavy or boring as much as the in-person interactions with students, because the online connection gave the opportunity to discuss one-to-many all common issues or mistakes in drawings. This simplified a lot of the ineffective repetitions. The experience did in the previous semesters aided a lot with such kinds of didactics. All sets of exercises were managed by means of “Activity” proposed in Teams, defining the timing of each work and collecting all materials directly in folders and squeezing to gain files dimensions. It was easy to have a strict check on the materials delivered and the students that were attending the course. Each graphical representation was examined and a report for each activity was sent to the classroom. Further group or individual meetings were organized to explain where mistakes were done.

In the examination, because was the first time that a digital platform was employed, special stress occurred trying to avoid cheating.

### 3 DIFFERENCES IN PERCEIVED QUALITY STUDENTS' ASSESSMENT

Every year the University of Calabria organizes a survey on all courses taught in all Degrees. All students attending the courses are invited to fill out a questionnaire, anonymously, in order to have a clear map of points of weakness or strength in all areas of teaching.

The survey is proposed when about 2/3 of the course has been taught and students can express their assessment with sufficient consciousness. The survey is interested not only in teacher assessment, but organization and scheduling, general satisfaction, and if the tasks are reached. Table 1 contains the percentages of positive answers to selected queries, those more significant for the paper. Each query admits 4 levels of assessments on a 4-point Likert scale, from strong negative to strong positive with two intermediate levels. Each percentage represents the ratio between the numbers of positive answers (strong and mild) with respect to the total number of answers for each query.

Table 1. Percentage of positive answers

Query	2017/2018	2019/2020	2020/2021
Q1: Is the teaching load proportionate to the credits assigned?	84.7	86.1	84.35
Q2: Does the teacher explain the arguments clearly?	71.0	71.45	70.65
Q3: Is the teacher available for clarifications and explanations?	93.5	92.5	98.4
Q4: Are the exercises useful for learning the subject?	76.4	88.1	90.6
Q5: Do the exercises have an appropriate level of difficulty (neither too low nor too high)?	79.2	80.85	90.6
Q6: Are you overall satisfied with how the exercises were carried out in laboratory?	65.3	77.3	82.45
Q7: Are you interested in the topics covered in the teaching?	91.6	94.0	92.6
Q8: Are you overall satisfied with this teaching?	75.0	75.4	84.05

Which differences occurred over the years? The figures depict an evolving dynamic that must be examined carefully.

There are answers that remain almost steady in time. These are Q1, Q2, and Q7. Students are interested in the topics covered by the course ( $Q7 = 92.7 \pm 1.2$ ) and that the workload is commensurate to the number of 12 ETCS established ( $Q1 = 85.5 \pm 1$ ). Also, the assessment of the teacher's didactic ability remains steady ( $Q2 = 71.0 \pm 0.5$ ) among the three different groups of students. These three answers give a sort of continuity along the time, that can aid to reflect on the other questions.

Queries Q4, Q5, and Q6 have a growing trend. Q4 and Q6 interest the satisfaction and the usefulness of laboratory. From the 2017/18 academic year to 2019/20, there is a high jump of about 12% that can be associated with a double phenomenon: the change of didactic approach from in-person to online; the change of instructors in the laboratory. In any case, there has been a further increase of 2.5% (Q4) and 5% (Q6) from 2019/20 to 2020/21, in consideration that instead of several instructors there has been only the teacher to support students by means of video conferences managed by Teams.

Query Q5 interests the level of difficulty of the exercises proposed in laboratory. This reached in both initial academic years taken into consideration (2017/18 and 2019/20) a similar value of  $80 \pm 0.8$ . The answer to this query jumped to 90.6 with an increase of +10% with the passage to full online didactics. In this context, the systematic employment of video recording of lectures and laboratory gave the opportunity to reply several times all the steps not well understood, without spending a lot of time waiting for asking teacher/instructors to clarify concepts or passages.

Query 3 follows the same trend of Q5 with a steady value of  $93 \pm 0.5$  in the first years and a jump of +5% in the academic year 2020/21, reaching the highest value of 98.4. This is absolutely associated with the perceived level of the nearness of the teacher guaranteed by chat-call-video and online discussions in which drawings are shared and mistakes are corrected by pen tablet and SketchBook®, in session one-to-one or one-to-many sessions, as described by authors in [10].

Also, the general level of satisfaction, relieved by Query 8, had a jump of about 9% from the first years (75%) and the last one (84%).

#### 4 DIFFERENCES IN MARKS OBTAINED BY STUDENTS

The second point of view is the analysis of the marks obtained by students at examinations. For the degree in Mechanical Engineering at Unical (University of Calabria), 5 calls are provided to students throughout the academic year to attend the examination of every course. Considering that the course of Machine Drawings ends in the second semester, the schedule of the calls is so planned: two in the period June-July; one in September; two in the following January-February.

Table 2 collects data from all calls in each academic year. Each column represents a call and the figures along with each row are associated with the number of people that turned in the assignment, those who failed it, and who passed the exam, then the average mark obtained and the standard deviation.

The first three calls, after the completion of the course, are more crowded. The last two can be considered supplementary and they are attended by a few students.

*Table 2. Percentage of positive answers*

A.Y. 2017/2018

Calls	June 2018	July 2018	Sept 2018	Jan 2019	Feb 2019	Total	%
Participants	16	25	25	10	7	83	
Not sufficient	4	10	15	3	7	39	47
Passed	12	15	10	7	0	44	53
Average Mark	25.33	25.60	25.60	23.57	0	25.20	
St. dev.	3.20	2.59	2.27	3.91	0	2.92	

A.Y. 2019/2020

Calls	June 2020	July 2020	Sept 2020	Jan 2021	Feb 2021	Total	%
Participants	33	22	20	7	7	89	
Not sufficient	15	14	12	3	3	47	53
Passed	18	8	8	4	4	42	47
Average Mark	26.44	23.63	23.50	21.50	21.75	24.30	
St. dev.	2.28	2.26	1.14	3.32	2.87	2.90	

A.Y. 2020/2021

Calls	June 2021	July 2021	Sept 2021	Jan 2022	Feb 2022	Total	%
Participants	33	41	42	4	8	128	
Not sufficient	21	21	22	4	6	74	58
Passed	12	20	20	0	2	54	42
Average Mark	27.33	25.79	24.20	0	24.5	25.44	
St. dev.	3.42	2.62	2.44	0	1.5	2.92	

Two are the elements that appear comparing the sub-tables. In the a.y. 2020/2021 there was a great number of students that attended the exam and turned in the assignments; 128 with respect to 85 (average value of both previous academic years). In the first call after the completion of the course, the average mark obtained in 2020/2021 was the highest with respect to all other calls.

A further investigation concerns the number of students that participate at least in one of the calls of the year. It should be taken into account that in Italy there is the possibility to attend to all the calls scheduled before passing the exam. This creates a really different dynamic to the fruitful pedagogical procedure and a frequent overlapping (or so close) of calls among different courses. As a matter of fact, the total number of participants to all year's calls, reported in Table 2 represents the summation of all the attendees to all calls, and some students can have been present in several calls, due to having failed in some of them. They do not pass the exam, probably, because they require additional time to produce sufficient content. Just to recall from the previous work presented at EPDE 2021 [10] the exam consists of the production of a certain number of parts/components extracted from an assembly complete with dimensions and tolerances (dimensional and geometrical), and the solution of a stack-up of one-dimensional tolerances.

Table 3 have been counted only the people that were present at least one time to the calls, without considering repetition. They can have passed or not the exam in the period taken into consideration. In any case, they are people that have completed all the preparatory work developed throughout the year

in the laboratory. This number is significant to assess the level of abandonment of this course, evaluated as complementary to the number of people attending the calls and compared to all people enrolled each year.

Table 3. Percentage of students that attended at least 1 call.

Academic Year	Students attending at least to 1 call	Students that compose the class	Participation to exam (%)	Abandonment (%)
2017/2018	56	132	42.42	57.58
2019/2020	57	135	42.22	57.78
2020/2021	81	143	56.64	43.36

The level of participation of students during 2020/2021 has been extraordinary. The level of abandonment reduced by more than 14 points, and relative to the initial years (almost at the same level) by about 25%.

Combining data from Table 2 and Table 3 the number of students that passed the exam can be compared among the different academic years. In 2017/2018 there was  $44/132=33.33\%$ ; in 2019/2020 there was  $42/135= 31.11\%$ ; in 2020/2021 there was  $54/143= 37.76\%$ . So, in this comparison, there has been an increase of +5.5% in passing the exam from the online edition with respect to the previous ones, characterized by an average value of 32.22%.

## 5 CONCLUSIONS

The employment of online didactics during the Covid19 pandemic has greatly changed the way in which the teacher/student relationship has been traditionally pursued [11]. Some results from data comparison among the academic years taken into account in the paper reveal that essentially the great advantages of online didactics have been:

- the nearness between teachers and students that allowed them to “give prompt feedback” to all kinds of questions asked by students, as documented by the value of 98.4% to the query Q3 in Table1.
- a finer check of the assignments and the completion of the homework managed by the “activity” organized in Teams, “emphasizing time on task”.

These two points are respectively the fourth and the fifth principle of the report on didactic quality for undergraduate education made in 1987 [12] in the USA. Now, these suggestions have been naturally performed by the online connection and the employment of the meeting software.

Even if in the current year didactics returned in-person, online methodic, tested during pandemic years, continues to be used especially for the management of homework and the connection with students for discussing the mistakes done on drawings.

Lectures are given in the classroom and conjointly online for supporting those students that are not able to attend them, because of a disease. At the same time, video recording is made for all lectures that can be consulted in an asynchronous way. Also, this year can be considered further experimentation, but with the consciousness to employ technologies that have become really friendly and fruitful.

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