

# PERCEPTION OF ADVANTAGES/DIFFICULTIES OF REMOTE TEACHING DURING COVID-19 PANDEMIC: RESULTS FROM A SURVEY WITH 3000 ITALIAN ENGINEERING STUDENTS

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## Abstract

On 11<sup>th</sup> March 2020, the Director-General of The World Health Organization declared COVID-19 a pandemic. From this date, in Italy as in most parts of the world, life dramatically changed in many aspects: smart working and remote teaching became familiar words, while students and teachers at all educational levels, from primary school to university, had to face sudden changes and new challenges. Emergency remote teaching became widespread, and new methodologies to deliver classes and courses were adopted by educational institutions.

In this paper, we focus on the impact of the remote learning experience on university students, in particular, engineering students enrolled at Politecnico di Milano. Subjects recruited from all engineering courses, from the first to the fifth year, were asked to fill in a multidimensional survey. Respondents participated in the study voluntarily and more than 3,000 students completed the entire survey. Overall, 60 items about the participants' perceptions about the challenges of emergency remote teaching, compared with the pre-Covid-19 usual in-presence teaching were included.

The survey addressed 6 dimensions: Organization of the emergency remote Teaching, Subjective Well Being, Metacognition, Self-Efficacy, Identity, and Socio-Demographic information. Preliminary results show significant differences in the students' perceptions concerning the following three factors: the effectiveness and the organization of the courses, the change in the university students' evaluation of their instructors, and the change in the university students' perception of difficulties in the switch from in-presence instruction to online learning. Data analysis also suggests a relevant impact of an emergency remote teaching on students' perceived Metacognition and Self Efficacy.

Keywords: Remote Teaching, Distance learning, COVID-19, Metacognition, Self Efficacy.

## 1 INTRODUCTION

In 1992 the invention of the World Wide Web gave a boost to online education. Researchers, educators, teachers, and students started to face new challenges in learning and teaching methodologies and strategies. Since then, universities started to propose entire courses online and platforms organizing Massive Open Online Courses (MOOCs) have also been [1]. So even if online education [2] was not something new, the outbreak of COVID-19 led to unprecedented changes [3], [4]. The COVID-19 pandemic forced almost the entire educational world to switch to online teaching [5]. According to UNESCO [6], more than 1.5 billion students worldwide (90.1% of total enrolled learners) have been affected by the COVID-19 closures and subsequent educational changes. The biggest change was the sudden transition from face-to-face instruction to total remote teaching [7], [8]. Not all universities were prepared for such a big and sudden conversion, and their online teaching-learning process evolved gradually. Universities immediately tried to reorganize the courses and improve teaching methodologies and instruments.

In February 2020, the Politecnico di Milano implemented a series of targeted and systemic actions in order to support the transition to completely online teaching and in order to guarantee the continuity of the activities that were previously carried out in the classroom. At first, the different didactic scenarios - different from each other and according to the courses' features and the teachers' attitudes - were mapped and some possible alternatives were proposed for each of them. In addition to technical support, a methodological accompaniment was also activated to help teachers understand how to design and manage entirely their online teaching and how to cope with the difficulties of the new context:

- Difficulties in adapting one's teaching to a completely different context;
- Perception of discomfort in carrying out online lessons without having immediate returns from the classroom;
- Willingness to offer active teaching also in the new context.

In this perspective, seminars were proposed. The main topics were: activating the virtual classroom, supporting student motivation, the management of groups and the reviews of papers, and the online assessment strategies. In parallel, continuous support was activated to intercept the needs and to respond by training seminars, discussion in small groups, or ad hoc consultancy. In September 2021, there was the transition to the extended classroom (part of the students online, part in the presence). This new approach required a further redesign of the different classroom sets and equip classrooms with audio-video systems integrated with the virtual rooms to allow the students in presence and the ones at home to use them efficiently. The classroom sets, the hardware, and the software set-ups were chosen referring to the basis of the Pedagogy-Space-Technology (PST) frameset by Radcliff [9], which emphasizes the connection between pedagogical approaches, and spaces and technological tools. Technical and methodological support and ad hoc interventions were activated also during the 2020-21 academic year. In the three years, 2019-2021, more than 70 seminars were proposed to the teachers of the Polytechnic and more than 7,500 stakeholders participated. The COVID-19 Impacts on Education Systems and the Future of Education have been analyzed by the researchers in many works [10]–[12], referring to the academic year 2019-2020 and the academic year 2020-2021. In these works, researchers analyzed the student's opinions about the difficulties encountered during remote teaching, the learning strategies used, and their feelings toward pairs and teachers. Building on these work, we carried out an in-depth survey (almost 70 questions) in which we asked the students enrolled in engineering courses at Politecnico di Milano about their perceptions in the following areas during remote teaching and in presence: psychological wellbeing, learning strategies, job perspective, and attitude toward being an engineer. We present in the following the entire survey and some primer results.

## 2 METHODOLOGY

In July 2021 we designed a survey building on a previous one [10] to the students enrolled in engineering courses delivered by Politecnico di Milano. The questionnaire was composed of 66 questions referring to the didactic activities held in the academic years 2019-2020 and 2020-2021. The participation was voluntary and we collected the answers by 3183 students. This sample was composed by N = 1057 (33,2%) female students and N = 2126 (66,8%) male students, respectively. About 70% of the sample was attending the Bachelor degree's courses, while the remaining 30% were attending Master degree's courses. We grouped the 66 items proposed in 6 subsections referring to Remote Teaching (RT), Subjective Well Being (SWB), Metacognition (MC), Self-Efficacy (SE), Identity (I), and Socio-Demographic information (SD).

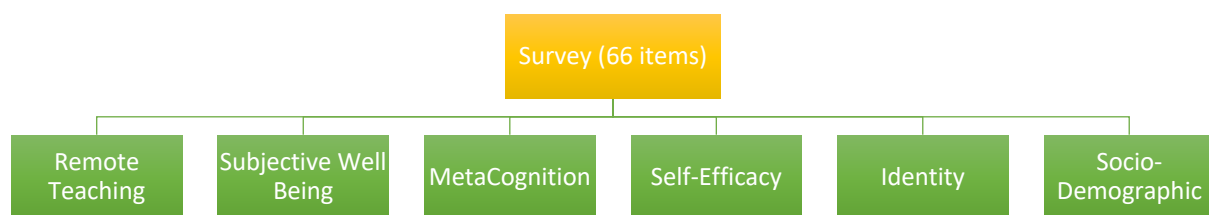


Figure 1. Description of the survey.

In the section *Remote Teaching*, we investigated the perception of the advantages and issues due to remote teaching, in particular referring to the effectiveness and organization of the courses, the change in the university students' evaluation of their instructors [13], and the change in the university students' perception of difficulties in the switch from in-presence instruction to online learning. The questions related to the worsening or improvement of the items under investigation with respect to the period before the pandemic, and the answer was proposed on a five-point Likert scale from 1 (not at all effective or definitely worse) to 5 (completely effective or definitely better). *Subjective Well Being* was measured with the *PANAS* (Positive Affect Negative Affect Schedule) scale [14]. This psychological instrument consists in a set of adjectives describing a positive or negative approach to the online lectures compared to face-to-face didactics. In the sections *Metacognition*, *Self-efficacy*, and *Identity* students were asked to rate the extent to which they agree or disagree with each statement on a scale from 1 (totally disagree)

to 5 (totally agree). Each statement was repeated twice, referring to perceptions before and during the remote teaching. The 15 items contained in the section *Metacognition* involved the student's cognitive processes: the monitoring, the control, and the regulation of the cognition [15]. For what concerns *Self Efficacy*, we proposed 10 questions referring to 'beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments' [16]. Finally, the section *Identity* is composed of 15 items [17], [18] concerning a sense of belonging to the engineering community, recognition of engineering role in society, intrinsic interest in engineering, self-image as an engineer, and confidence in own skills to be an engineer. Furthermore, in the survey, there are 7 items about socio-demographic information like gender, high school attended, and type and number of devices used during the online education period.

### 3 RESULTS

We analyzed the collected data using descriptive statistics. We used the statistical software SPSS by IBM and R by R Foundation for Statistical Computing. In table 1 we report the mean values for the sections Remote Teaching (RT), Metacognition (MC) and Self Efficacy (SE) before (PRE) and during remote teaching (NOW).

Table 1. Descriptive statistics.

	<i>Mean</i>	<i>St.Dev</i>	<i>Median</i>
<b>Remote Teaching</b>	2,93	0,70	2,86
<b>Metacognition PRE</b>	3,33	0,68	3,33
<b>Metacognition NOW</b>	3,47	0,68	3,48
<b>Self-Efficacy PRE</b>	3,20	0,74	3,10
<b>Self-Efficacy NOW</b>	3,15	0,79	3,10

We note that the mean value is higher than the neutral value except for RT where the average is just below 3. This last result has been explored in more detail, by analyzing the items grouped in the three subsections: A) the effectiveness and organization of the course, B) the evaluation of the instructors, and C) the perceived difficulties due to the transition in online learning modality. We also computed the descriptive statistics concerning the item that obtained the higher and the lower mean value, respectively Question 2 (Q2) and Question 11(Q11) as reported in Tab. 2.

Table 2. Descriptive statistics concerning Q2 and Q11.

<i>ITEMS</i>	<i>Mean</i>	<i>St.Dev</i>	<i>Median</i>
Q2: what do you think about remote teaching that was proposed in your courses, due to COVID-19?	3,85	0,95	4
Q11: How your interaction with your pairs has changed during the remote teaching experience with respect to the experience in presence ?	1,81	1,01	1

Furthermore in Fig.2 we reported the mean values of the three factors concerning Remote Teaching. Results show that students appreciated how Politecnico has organized Online teaching, while, as expected, they complained about the relationship with their peers and the interactions with teachers.

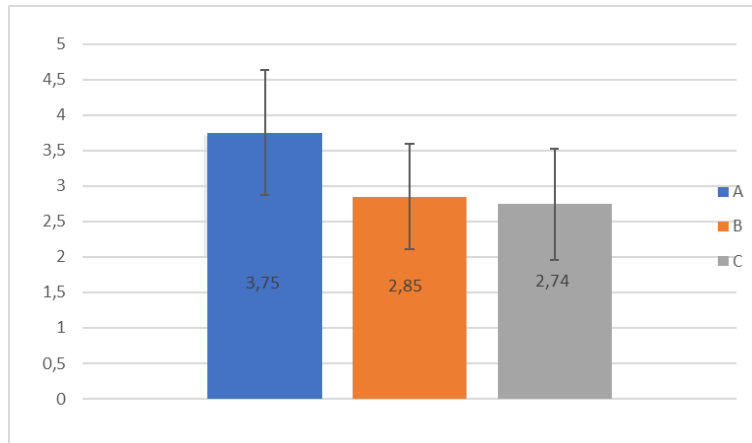


Figure 2. Mean value of the raw scores of the three RT's factors: A) the effectiveness and the organization of the course, B) the evaluation of the instructors, and C) the perceived difficulties due to the switch to the online learning modality. Whiskers indicate standard deviation.

In order to investigate the perceptions related to Metacognition and Self Efficacy, we analyzed the distribution of the answers and compared the scores given by students referring to before the pandemic and during the remote teaching. We computed the percentage differences of items with the same score before pandemic and during remote teaching, for both sections. In figure 3, the percentage increase or decrease for the sections MC and SE are reported; in Metacognition there was a decrease in lower and neutral score in favor of an increase in higher score 4 and 5, while in Self Efficacy the answers' shift seem to be almost in the opposite side.

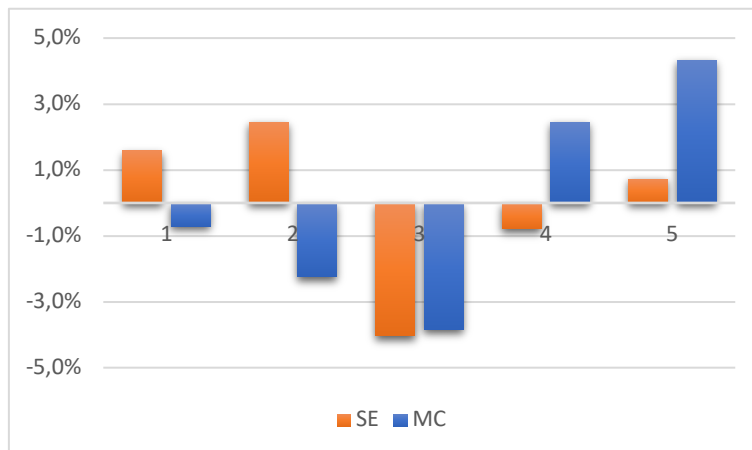


Figure 3. Percentage difference of the answers that obtained the same score referring to before pandemic and to remote teaching.

Finally, we looked at whether results concerning RT depended on gender (see table 3). The small difference between male and female in the mean value could suggest a different evaluation of the Remote Teaching, but the only descriptive statistics cannot confirm this perception.

Table 3. Mean value, standard deviation and median of males and females' answers concerning Remote Teaching

	Mean	St.Dev	Median
<b>Remote Teaching MALE</b>	2,95	0,72	2,93
<b>Remote Teaching FEMALE</b>	2,90	0,66	2,86

## 4 CONCLUSIONS

More than 3000 students studying at the Politecnico di Milano participated in a survey concerning the Online Education in the engineering courses during the COVID-19 Pandemic. Our preliminary analysis suggests that engineering students appreciated the effectiveness and organization of the course, enacted during Remote Teaching experience. This result is probably linked to the efforts and the support that was immediately and subsequently provided, as described in the introduction. At the same time, we noticed how the relationship with peers and the interactions with the instructors were perceived as worsened from a student's point of view. Concerning Metacognition, we note a small increase in the mean value (+ 0,14), likely linked to how students dealt with the difficulties due to remote teaching. On the opposite side, we noticed that the perception of Self Efficacy is almost not changed during the COVID-19 pandemic concerning the period in presence. In both cases, Metacognition and Self Efficacy, the mean values were higher than the neutral score, as the starting point was good enough to face new challenges in didactics. Finally, we looked at the scores' differences due to gender. Also, in this case, our analysis indicates that gender does not influence significantly the students' perception of difficulties during the emergency remote teaching.

As further steps, we will check the reliability of each factor to establish the internal consistency of the items. Then, we will include the effects of other contextual variables, such as the year of the academic course attended and type of engineering course.

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