STUDENTS' DIGITAL COMPETENCIES IN REMOTE AND ONLINE HIGHER EDUCATION IN THE SECURITY AND DEFENCE FIELD

Marina Marchisio, Fabio Roman, Matteo Sacchet, Enrico Spinello, University of Turin, Italy

Abstract

Using digital tools for teaching and learning has become quite common in the latest years: while already before the year 2020 their use had been constantly increasing, the breakout of the COVID-19 pandemic at the beginning of the current decade gave a strong impulse to their diffusion. This phenomenon has become enduring also now that the presence of the virus does no longer constitute an emergency, with a view that certain changes will become essentially permanent. The use of digital tools in teaching brings some advantages, for example by allowing to teach and learn at a distance, but also challenges, since moving from using PCs and other devices for everyday life to using them in educational contexts is less straightforward than expected. In this research, we analyse how students perceived higher education during the transition scenario implied by the pandemic, through a survey delivered to military and civilian students enrolled in security and defence studies, which investigates students feelings while undergoing relevant changes in their educational habits. From the analysis of the questionnaire, it resulted that students had trouble, among other things, relating with teachers and feeling the same intensity of engagement when unable to see them in person. This research is part of the activities of the European project DIGICODE, aimed at the improvement of education quality in security and defence by fostering the correct use of digital tools, and by developing the relative competencies in both students and teachers.

Keywords:

digital education, distance learning, online education, security and defence, student training

1 Introduction

International cooperation is pivotal in the security and defence contexts to stand together against today's threats. For the sake of cooperating skillfully and in the long run, it is better if military officers and civilians involved in the security and defence area cooperate early in their studies, for example when they are still students or in training (Marchisio & Spinello, 2021). This implies the use of appropriate tools allowing such a cooperation, such as e-learning, which nowadays provides a wide support to various teaching modalities: blended learning (Marchisio et al., 2022a), hybrid learning (Marchisio et al., 2022b), and more in general modalities which do not require a course to be taken purely online, allowing to strategically internazionalize the educational setting (Mihalova, 2006). While the diffusion of e-learning started with the computer and information revolution, being well under way during the 2010s, the event that caused a big leap forward in its use all around the world was the COVID-19 pandemic (Hodges et al., 2020). Inviting teachers, students, and more in general all the stakeholders to undergo specific training is important because it shows them how education is related to a peculiar use of the digital tools, which even people born in the computer age do not necessarily master in the best way possible before having acquired some appropriate expertise. The DIGICODE project implements this opportunity at European level, with the involvement of several nations like Bulgaria, Italy, Poland, and Romania. Its name stands for *Digital Competencies for Improving Security and Defence Education*, being an Erasmus+ Key Action 2 Strategic Partnership project, funded by the European Union. Its scope is to improve security and defence education, by benefitting from a didactic use of digital tools. In this paper, we are going to investigate the status of digital competencies of students before and during the COVID-19 pandemic by analyzing a questionnaire administered to students, asking them to rate several aspects such as: engagement, communication, development of digital competencies, and achievement of learning outcomes. Furthermore, we compare students' time management when working with computers and electronic devices. The sample is composed by Italian students enrolled in security and defence courses, which are cross-disciplinary studies strongly focused on international cooperation. A similar survey addressed to teachers has been already delivered and analyzed (Marchisio et al., 2022c), allowing us to set up comparisons between the two sides. The paper is structured as follows: Section 2 presents the state of the art, and Section 3 is devoted to the research question and the methodology. Section 4 reports all the results, while Section 5 sets up the relative discussion. Finally, some concluding remarks are reported in Section 6.

2 State of the art

Several recent studies addressed the opportunity of acquiring digital competencies in the security and defence setting. First, it is clear that digital tools provide the basis for e-learning, thus requiring all the stakeholders to be digitally competent, and in particular in relation with education. A criticality arises when these skills are overestimated, leading people to believe that what they know is sufficient to perform adequately, and that in case they need help, they will always be able to rely on others who know the tools better. This is a feeling spread among both students (Buffardi & Taddeo, 2017) and teachers (Tomczyk, 2021), which results in thinking that to acquire proper digital competencies is less important than it actually is. (Pinchuk & Prokopenko, 2021) analyzed the experience in modern educational approaches to STEM subjects in various countries: United States, Australia, China, Britain, Israel, Korea, and Singapore. This resulted in the possibility of implementing transdisciplinary integration while providing advanced training to the officers of the Armed Forces of Ukraine, the authors' native country. (Barron & Rowles, 2021) highlighted the importance of digital literacy also for specific military branches, such as Air Force. It has long been established that learning to use technology in general and learning to fine-tune it for education are quite different paths, since in the latter case the technical tools are the means rather than the scope (Goldin & Katz, 2009), implying the involvement of various other skills (Van Laar et al., 2017). A widely recognized criticality regards the fact that, albeit the competencies in digital fully fit into the *future skills* notion (Ehlers, 2020, and references therein), almost a half of Europeans lack even the basic skills, with a gender gap and a digital divide making the situation even worse, as per 2017 data (European Education Area, 2020). In 2020, the European Union published the Digital Education Action Plan (DEAP), outlining how digital competencies in education are strategic; it has been this declaration that inspired the outset of the DIGICODE project. In general, these skills are pivotal for addressing the challenges of educating sustainably (Mentsiev et al., 2022), fitting into the UN Sustainable Development Goals (United Nations, 2015).

3 Research question and methodology

We motivated our study with the need to give an answer to the following research question: *How did Italian students perceive higher education in a transition scenario requiring the use of digital skills, and how can these skills be improved?* The transition scenario is given by the disruptive changes in the use of digital tools in education provided by COVID-19 pandemic. This resulted in a survey in which both quantitative and qualitative aspects have been put under scrutiny, but here we focus on the former ones, since they are better suited for setting up a comparison between the situations before and during the COVID-19 pandemic. Furthermore, they also allow us to make a comparison between the students' and the teachers' perceptions, thus highlighting similarities and differences in how both stakeholders felt the scenario. We collected data from 361 Italian third year Bachelor students and Master students in Strategic Sciences, divided by age and gender as follows:

Table 0: Distribution of the students by age and gender

Age range	Females	Males	Did not specify
19-22 years old	29	84	0
23-25 years old	41	161	2
Over 25 years old	6	34	4

It must be noted that there is still a gender difference in the sample, but it is by now intrinsic in the current population of students, which is anyway representative. About 90% of them are military students, while the remaining 10% are civilians. They are almost equally divided between bachelor and master students, with a slight predominance of the former.

For the ratings, we set up a five-level Likert scale, in which 1 stands for the lowest score and 5 for the highest one; for the time spent, we used categorizations, in a case basically corresponding to the actual number of daily hours, in the other case encompassing reasonable ranges of weekly hours (e.g. "from 10 to 20 hours"). We analyzed the resulting numerical data both descriptively and inferentially, allowing on the one hand to clearly show the differences (if present), and on the other hand to state for them a solid significance under the statistical point of view.

4 Results

We compared pairs of questions investigating the situation before and during the COVID-19 pandemic, by means of Likert scales in Pairs 1-4, and categorical levels in Pairs 5-6. In the following tables, the word "before" stands

for “before the pandemic, in a face-to-face context” while “during” stands for “during the pandemic, in emergency or online context”.

Pair 1: how do you perceive your personal engagement?

Table 1: Rating of personal engagement by students

Engagement	Before	During	Difference
Very low (1)	5	9	+4
Low (2)	8	39	+31
Average (3)	64	116	+52
Good (4)	176	150	-26
Very good (5)	108	47	-61

Table 1 shows a diminution in how well students perceived their engagement in the pandemic setting: the generally lower scores, with 160 of them decreasing while only 44 of them increased (157 of them remained the same), are confirmed by observing that their average decreased from 4.04 (standard deviation: 0.83) to 3.52 (standard deviation: 0.94). Pairing data results in a differences’ mean of -0.52 (standard deviation: 1.13), and inferential tests allow us to determine that this deterioration is statistically significant, resulting in the z-scores of a paired Wilcoxon signed-rank test and a paired t-test (both normally approximated) to be respectively 7.67 and 8.62, while it is general sufficient to have values higher than 3 in order to deem the variation significant. The practical consequence is that students found it difficult to engage remotely with the same intensity they were able to feel in classroom.

Pair 2: how do you rate your communication with teachers?

Table 2: Rating of communication with teachers

Communication	Before	During	Difference
Very low (1)	3	8	+5
Low (2)	12	43	+31
Average (3)	73	125	+52
Good (4)	187	147	-40
Very good (5)	86	38	-48

Table 2 shows again a diminution, this time concerning the quality of communication. 141 scores decreased, only 34 of them increased, and 186 of them did not change, resulting in the average falling from 3.94 (standard deviation: 0.80) to 3.45 (standard deviation: 0.91), being the differences’ mean -0.49 (standard deviation: 1.03). Also here, z-scores allow us to state statistical significance, being them 7.92 for Wilcoxon and 9.02 for the t-test. This suggests that students had difficulties in feeling equally at ease in conferring with teachers at a distance rather than face-to-face, even if in general young people are more prone to communicate in ways that do not require the parts to be present in the same place and at the same time.

Pair 3: how do you rate your own development of digital competencies?

Table 3: Rating of development of digital competencies

Digital competencies	Before	During	Difference
Very low (1)	4	3	-1
Low (2)	19	10	-9
Average (3)	107	87	-20
Good (4)	172	197	+25
Very good (5)	59	64	+5

Contrarily to Tables 1-2, Table 3 shows an increment: 87 scores increased, 47 of them decreased, and 227 of them did not change, with the average rising from 3.73 (standard deviation: 0.84) to 3.86 (standard deviation: 0.76), and the differences’ mean having the value 0.13 (standard deviation: 0.76). In this case, the z-scores are 2.90 for Wilcoxon and 3.17 for the t-test, so the variation is statistically significant with a p-value less than 0.01, but significance is lower than noticed for Pairs 1-2. This can be interpreted as the students developing some

digital competencies because the situation required it, but doing it not necessarily uniformly, since a high number of students (more than the 60%), in fact, did not improve those competencies according to what they declared.

Pair 4: how do you rate your achievement of the learning outcomes?

Table 4: Rating of achievement of the learning outcomes

Learning outcomes	Before	During	Difference
Very low (1)	5	4	-1
Low (2)	10	10	0
Average (3)	95	105	+10
Good (4)	189	191	+2
Very good (5)	62	51	-11

In this case, Table 4 shows a basically balanced situation: 55 scores increased, 71 of them decreased, and 235 of them did not change, with the average moving from 3.81 (standard deviation: 0.80) to 3.76 (standard deviation: 0.77), thus varying of 0.05 (the standard deviation of the differences' mean is 0.84). These changes appear to be quite weak, and this is confirmed by the z-scores, being 1.41 for Wilcoxon and 1.13 for the t-test, thus deeming statistical insignificance (the p-value is higher than 0.05). The interpretation for this may concern the fact that students may have felt satisfied of what they were able to achieve as learners in the transition scenario, since after all the uncertainty could have resulted in even more difficulties.

Pair 5: how many hours per day do you spend on the PC for learning purposes?

Table 5: Daily time spent in front of a PC

Daily time in front of PC	Before	During	Difference
Less than 1 hour (1)	88	20	-68
About 2 hours (2)	114	42	-72
About 3 hours (3)	61	53	-8
About 4 hours (4)	30	54	+24
About 5 hours (5)	17	50	+33
6 hours or more (6)	17	108	+91

Here, we exclude from the analysis 34 students answering "It's hard to say" to the question relative to the pre-pandemic period, thus restricting (just slightly) our sample to 327 of them. The increments are prominent: the number of hours increased 225 times, while it decreased only 32 times (70 times it remained the same); the average augmented from 2.46 (standard deviation: 1.38) to 4.21 (standard deviation: 1.63), a jump of 1.75 (the standard deviation of the differences' mean is 1.98). The confirmation that z-scores can give is overwhelming: 11.80 for Wilcoxon and 16.73 for the t-test are the highest scores of all the pairs we considered. This means that most students required more time to spend in front of the PC, with the difference being considerable for several of them, albeit a minority did not require more time, some of them requiring even less time. The 30% of students requiring less or the same time reasonably used the PC enough already before the transition, an aspect related to the evidence the next pair of questions will show. It must be noted that these students used the PC enough, but not a lot before the pandemic, since there is a substantial uniformity with respect to the declared number of hours.

Pair 6: how much time per week do you spend studying for classes?

Table 6: Weekly time spent studying for classes

Weekly study time	Before	During	Difference
Less than 1 hour (1)	21	24	+3
From 1 to 4 hours (2)	113	102	-11
From 4 to 10 hours (3)	132	130	-2
From 10 to 20 hours (4)	64	74	+10
More than 20 hours (5)	31	31	0

In the last pair of questions, the situation is again balanced, with the category increasing 79 times and decreasing 75 times, along with 207 times in which it did not change. The increment of the average is from 2.92 (standard

deviation: 1.03) to 2.96 (standard deviation: 1.05), resulting in a differences' mean of 0.04 (standard deviation: 1.02). As for the case of Pair 4, there is no significance in these modifications, a fact that z-scores indeed confirms by giving 0.83 for Wilcoxon and 0.78 for the t-test, implying a p-value higher than 0.05 and thus the inability to refuse the changes' insignificance (null hypothesis). Consequently, students did not feel the need to considerably increase the time they devoted to studying, by generally assuming they did it enough already before the COVID-19. It can be objected that how the scale is subdivided could affect these considerations, but the proximity of the numbers relative to increments and decrements would reasonably suggest the absence of a sound trend anyway.

5 Discussion

All these results can be related to the theoretical framework and the research questions. The averages' decrease in Pairs 1-2 (engagement and communication) and the increasing standard deviations suggest that diverse students react, at least up to a certain extent, differently to the challenges brought about by the pandemic, in part probably due to different starting conditions. Personalized learning paths could overcome diversity. A specific training to develop digital competencies, which are not uniform among students, could also be useful (Pair 3). It would have been reasonable to find increments in Pair 5, but trained students would consistently require less time to deal with technical matters, thus partially reducing the additional time they had to use the PC. Finally, the results shown in Pair 4 (learning outcomes) and Pair 6 (weekly study time) depict an already satisfactory situation, even if different students' engagement could improve the quality of the studying time. Another important aspect concerns the fact that it is also a matter of accommodation: it requires time to get used to changes, even if they are positive. In our context, this accommodation depends on how much students use technologies in education. It is clear that teachers should lead by example by using digital tools in the first instance. We can also compare the results just obtained with the analogous survey regarding teachers, depicted in (Marchisio et al., 2022c). Pairs 1-2 are strictly related with questions we asked teachers, namely those requiring them to rate the engagement of students (mirroring Pair 1), and the communication with students (mirroring Pair 2). In both cases, we see a statistically supported degradation of the ratings; this means that *both* sides shared the perception that students engaged with more difficulty, and that communication became more difficult in each direction, i.e. teachers communicated less easily with students and viceversa. A similar accordance concerns Pair 5, given that we asked teachers how many hours per day they spent at the PC for teaching (or preparing teaching) purposes. Both students and teachers experienced a sharp increase in the daily time they had to spend on computer for educational purposes, thus confirming the inevitability for each stakeholder of dealing with digital tools, by far more than what was required before. Pairs 3-4 are less related to the question we asked teachers; finally, with Pair 6 we return to a higher similarity, but if teachers required more time to perform their commitments, this is not true for students, since no statistically significant evidence occurred. This can be explained by the fact that it may be easier to adapt the learning to new scenarios rather than the teaching.

6 Conclusions and future works

This research gave us insights regarding how students changed their perception of higher education in the transition scenario implied by the COVID-19 pandemic. These modifications, due also to different perceptions in how they felt accommodated while undergoing relevant changes in their habits, have been related to practical consequences. They mainly consisted in difficulties in handling the didactic potential of digital tools (also here, with differences between students), a limitation that can be overcome by digitally competent teachers and organizations, making students acquire more specific competencies compared to those they already possessed. In addition, the delivery of interdisciplinary activities using digital tools and related innovative methodologies can help students have a broader vision of the matter. Some attempts have been done in two editions of the school "Systems for Command and Control in Security and Defence Field" in the framework of the DIGICODE project and the impact school design on teachers and school activities on students will be studied. An action of this kind is not exclusive to the security and the defence education, but given the internationality of this setting, implied by the needs of a wide collaboration against the threats in the present world, it constitutes a noteworthy context in which to apply it. As further future work, we can on the one hand extend the analysis to an international sample, after having disseminated the questionnaire among our foreign partners, and on the other hand repeat the study after proper intervention on programs and courses, looking for students' improvements.

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