A cross-case analysis of ICT courses in teacher training programmes for special needs: Technology affordances and Universal Design for Learning
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Abstract
The special needs teacher is a highly qualified professional whose role is to work in collaboration with all class teachers to activate an inclusive approach for the benefit of all students and to enable individual potentialities. Technology can be of paramount importance in designing learning activities according to the principles of Universal Design for Learning in an interdisciplinary approach and with a holistic perspective of all involved actors in the teaching/learning process. In Italy, the prospective special needs teacher has the opportunity to be fully trained thanks to a comprehensive specialization course where the areas of competence of digital literacy are addressed in a specific course. The study reports a cross analysis of three editions of an Information and Communication Technology course, with a focus on the results of the last edition, whose online format was discussed starting from strengths identified in the first two face-to-face editions of the same course.
Keywords: Instructional Design; Inclusion; Teacher Training; Educational Technology.

1. Introduction

In Italy, the teacher training programme for special needs represents an academic learning specialization path established by the Ministry of Education (Ministerial Decree 9 August 2013, n. 706) to train professional supporting teachers to be fully integrated into classrooms where students with disabilities are present. The specialized teacher works in strict collaboration with all class

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disciplinary teachers to facilitate an inclusive approach for all students and to support the design of individualized and personalized plans.

The training programme (60 ECTS) is a comprehensive learning opportunity that includes discipline-specific content along with psycho-pedagogical, methodological-didactical, organizational and relational areas of competence and is organized with frontal classes, laboratory sessions and an internship. The Information and Communication Technology (ICT) course covers 75 hours within the programme of instruction and addresses learning objectives at both the theoretical and practical levels.

The aim of the study, here described, is to present a cross-case analysis of the three last editions of the ICT course developed at the University of Macerata (Italy). The study takes into account the results discussed in previous analysis on the first two editions of the course (Fedeli & Pennazio, 2019; Fedeli, 2021b) in order to highlight some reflections on the role of technology-enhanced learning in the last edition of the course that, differently from the first two editions, was fully developed online.

2. Theoretical background

Technology-enhanced learning (TEL) can represent an opportunity to explore inclusive connotations of the teaching/learning process (Passey, 2019), since it enables different layers of learning space and time (Fedeli, 2021a) that can take advantage of both synchronous and asynchronous communication and interaction channels. Online learning management systems and videoconferencing tools can offer an integrated space and time where engaging approaches within active learning pedagogy, such as cooperative learning (Johnson et al., 1994), peer tutoring (Topping, 1987), reciprocal and team teaching (York-Barr et al., 2004), can be managed by all involved actors with a variety of interactional scenarios (real-time and own time). Students can access online resources made available in different digital formats (e-books, conceptual maps, etc.) and representational modalities (annotated text, audio comments, etc.). Online environments and digital tools can become catalysts for change in the educational process (Laurillard, 2009) and embrace the requirements of Universal Design for Learning (UDL) (Evmenova, 2018; Hamlin, 2015; Morra, & Reynolds, 2010).

Technology affordances and UDL principles, and the relationships between them, have been widely explored (CAST, 2018; Hall et al., 2012; King-Sears, 2009); the UDL conceptual framework "aims at offering teaching/learning principles which can satisfy all students' needs by making teachers/educators able to design activity plans where equal opportunities for each student is the

priority. TEL environments can create learning ecologies where digital technology can help offer a flexible learning approach able to overcome information access barriers and learning obstacles" (Fedeli, 2021c p.171).

The design and implementation of online TEL environments in the direction of the application of UDL principles, namely "engagement, representation, and action and expression", needs to be supported by research studies focused on instructional design (Edyburn, 2010) that explore the drivers able to foster the development of key abilities, as highlighted by the UDL approach – "access", "build" and "internalize" – that can help trainee teachers reach a proficiency as prospective special needs teaching professionals.

The flexibility of the online learning space and time as well as the characteristics of digital content (variability, modularity, transcoding) make it easier to reach the objective of offering accessible content on sensory and cognitive levels appropriate for any learner. At the same time, it is crucial to understand how online courses can satisfy the need for active learning, helping students to create their own relationships in the group class and to build a self-confident attitude in the expression of their actions and in the reflective processes to internalize successful learning strategies.

Teacher training in the direction of a full exploitation of opportunities of online environments and digitalized resources is consistent with digital literacy goals set by national ministerial plans and European frameworks (Fedeli, 2017; Tomczyk & Fedeli, 2022).

3. Case-study: cross analysis

A longitudinal analysis was developed to display and discuss the design process of three editions of the ICT course taught by the same professor in the academic years 2016-2017, 2018-2019 and 2019-2020. The qualitative multiple-case design (Baxter & Jack, 2008; Yin, 2014) is widely reported in the literature as an appropriate methodology to be applied in research studies which address educational and didactical purposes (Schoch, 2019).

The first two editions of the ICT course (Table 1) were taught in a face-to-face modality by taking advantage of a computer lab where trainee teachers could use the available devices, either individually or in small groups, to develop their activities.

Most of the didactic activities were performed synchronously during classes, with the addition of an online space to aggregate resources and archive completed activities; in the 2018-2019 edition the function of the online environment was enhanced by using a dedicated Learning Management System (LMS) and by proposing a set of asynchronous activities (e.g. discussions in

forums). Strengths highlighted by course participants (Fedeli & Pennazio, 2019; Fedeli, 2021b) include the approach used, that is, the chance to work in team-based projects where different attitudes, expertise and backgrounds could benefit from a deep peer support and cooperative learning activity design. Additionally, the sequential and gradual selection of content addressed in the course enabled participants to reach digital literacy at different levels (technical, cognitive and ethical), starting from the acquisition of basic skills of image editing to more complex skills of animation production. The overall balance between individual and group activities and synchronous and asynchronous activities were shown to be an effective strategy to convey an awareness of UDL principles.

Table 1 - First two editions of the ICT course and cross analysis

Edition	Teaching and learning space and time	Content	Activities	Approach
2016-2017 [2]	Synchronous face-to-face classes; ICT lab facilities (desktop PC; Internet connection; online task aggregator space)	(1) Digital formats and editing tools; (2) digital visual organizers; (3) digital production	Individual and small-group learning	Frontal classes, collaborative team work
2018-2019 [3]	Synchronous face-to-face classes; ICT lab facilities (desktop PC; Internet connection; institutional learning management system with asynchronous communication channels)	(1) Digital formats and editing tools; (2) digital visual organizers; (3) digital production; (4) instructional design and technology	Individual learning and work in pairs, small groups, and a collective	Frontal classes, cooperative learning; reciprocal teaching and real-time peer tutoring and teacher feedback

3.1. ICT course design: the online edition

The 2019-2020 online edition of the course was developed with the support of two institutional environments, a videoconferencing system (Microsoft TEAMS) and an LMS (OLAT). The instructional process was organized around synchronous sessions in TEAMS (frontal classes and group work) and asynchronous activities (additional discussions, feedback and reflections through forums).

Specifically, the integration of the two online teaching/learning spaces and times satisfied the following objectives:

- TEAMS was used for a direct interaction with trainee teachers during the frontal classes and the group work where all participants could

autonomously manage a dedicated channel. The opportunity to interact in real time can encourage the community-building process and peer support by organizing heterogeneous groups that can vary from activity to activity;
- OLAT was mainly used to offer a structured learning path, where trainee teachers could find a reference space with the visualization of the modules by following the sequence of the synchronous online classes, and with the opportunity to enhance the impact of the related activities with the availability of study resources and guidelines to deepen the subject matter. The LMS also provided a support forum where participants could post help requests if needed.

Instructional design choices had the objective of adapting identified past strengths in order to be effective in the online context. Most of the characteristics of the previous editions in terms of content and didactic approach were maintained (Table 2), with some small changes in the balance and the impact of synchronous/asynchronous activities.

Table 2 - Design choices in the last edition of the ICT course

Edition	Teaching and learning space and time	Content	Activities	Approach
2019-2020	Synchronous online classes via videoconferencing system + institutional LMS with asynchronous communication channels. Trainee teachers used their own personal devices.	(1) Digital formats and editing tools; (2) digital visual organizers; (3) digital production; (4) instructional design and technology.	Individual, small-group and collective learning.	Frontal classes, cooperative learning; reciprocal teaching and peer and teacher real-time and asynchronous feedback.

Activities were organized around five macro themes (images, infographics, maps, e-books, animations) that should enable trainee teachers to develop editing and production skills and to address accessibility and usability when dealing with digital content and formats. Specifically, however, those activities and the approach used to develop the learning process (e.g. reciprocal teaching, peer support, etc.) were aimed at improving the instructional design competences in the direction of UDL principles.

A major focus was on asynchronous professor and peer feedback by using LMS tools such as forums that let all involved actors take advantage of expanded reflection time while being engaged in an interactive written exchange (Fig. 1a and Fig. 1b).

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Fig. 1a - Screenshot of the LMS course structure with peer assessment activity of Module1

Fig. 1b - Screenshot of the LMS forum threads for peer assessment activity of Module1

The course, organized in five modules, ended with a final group task that required the creation of a lesson plan in which one or more digital artefacts were included in order to address specific subject matter and related learning objectives. Plans, artefacts (e.g. animations, e-books, etc.) and their presentation during the last course class underwent a formative assessment by

the course professor and were the object of open discussion collectively by peers in terms of efficacy for inclusive learning paths.

3.2 Data collection and analysis

The third edition of the ICT course (2019-2020) involved 44 participants following either the pre-school curriculum (7 people) or the primary school curriculum (37 people). At the beginning of the course, an initial questionnaire was completed to collect demographic data and open answers from participants connected to their work experience and perceived expertise in the areas of the ICT course and special needs.

Almost half of the trainee teachers were of middle age (41-50 years), with just a few of them (2) having had minor or no teaching experience (Fig. 2); the other most numerous group reflected trainee teachers aged 31-40 with fixed-term school employment that ranged from 1 to 10 years.

The most consistent data are those related to younger participants (24-30) with an initial experience of 1-3 years. The data showed that older respondents did not necessarily correspond to a stabler employment status, and this fact is relevant for analysing the approach and the effort during the course.

Content analysis was applied to open answers to trace information about participants' practical expertise with technology and their perception of the role of technology for inclusion. Most of the respondents who reported having already taken training courses about the educational/didactic use of technologies (22) referred to seminars on IWB (interactive whiteboards) and mobile devices (tablet and apps) followed by instruction on the G-Suite platform (widely used by Italian scholastic institutions at all grades), and few of them reported having completed the ICDL (Computer Driving Licence) Full Standard programme. Moreover, five of these people specified that they had already completed the ICT course in the teacher training programme for special needs at a different school level (pre-school level or middle school level).

The overview obtained with the entry questionnaire enabled the course professor to gain useful inputs to modulate some methodological choices for the collaborative work, for example, to create heterogeneous teams where more experienced participants could act as tutors and activate a modelling effect of peer support.

Most of the trainee teachers' statements about the role of technology for inclusion at the class level (teaching/learning process) and the school level (communication among different actors of the formative process: teachers, parents, external experts, territorial health officials, etc.) appeared extremely vague about the perceived advantages technology can offer in terms of the generic potential of engagement for active participation. More experienced

respondents showed a mastery in the choice of words to express their idea of technology's roles (didactical lexicon), such as references to "cognitive styles", "cooperative learning", "modelling", etc., but without providing a clear description of what can be actually done in terms of inclusion.
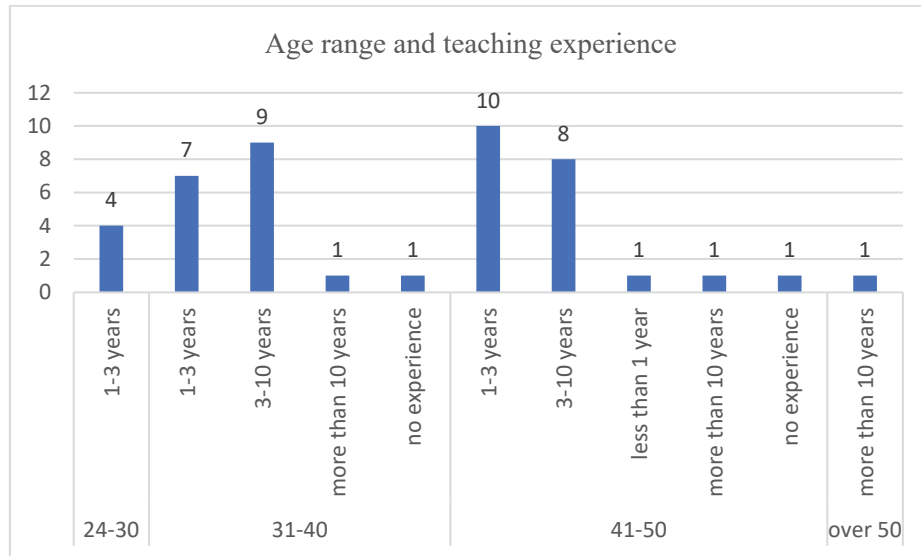

Fig. 2 - Age range and teaching experience of respondents

Additional data were collected during the course thanks to continuous participant observation (mostly recorded through anecdotal notes) that was run both in the synchronous group work and during the asynchronous activities in the LMSs (discussion forums). Specifically, attitudes towards negotiation processes and organizational strategies were the focus of annotation in the collaborative activities and during peer support, while modelling behaviours were observed in the discussion threads available for some of the activities. All of the professor's notes were analysed to collect inputs in the main interpretative indigenous categories already mentioned.

Trainee teachers had the opportunity to practice and experience as beneficiaries the approaches and strategies they already knew (or partially were aware of) as theoretical disciplinary principles of didactics.

The task performed during activities and the reflection processes activated through open discussions and experience exchange were used by trainee teachers in their final course requirement as a practical and cognitive "tool box" to design a lesson plan where digital multimedia/multimodal artefacts could be integrated to activate an inclusive teaching/learning process.

The final outputs of the 12 groups (3-4 people for each team) represented a relevant source of data in terms of participants' approach to technology when applied to instructional design.

The three different products (lesson plan, multimedia artefact/s, presentation) are the results of learning processes based on trainee teachers' understanding of designing for inclusion, the appropriateness of digital communication channels/formats for different target audiences, and the concept of balance (what media, in what extent, etc.) in creating digital resources.

Criteria used to analyse the outputs and draw reflections on participants' acquired skills and competences towards an inclusive approach to technology in class were the following:
- Lesson plan: the choice of the elements to be included and the way they were reported (e.g. objectives, students' prerequisites, description of the class as a relational ecosystem);
- Multimedia artefact/s: the tools and media used, the phase of the lesson in which it/they was/were included and the function/s it/they was/were expected to have;
- The presentation: the priority given to the different aspects of the work, the lexicon used and the layout and overall organization of the digital characteristics of the presentation (e.g. use of images in terms of accessibility).

The level of awareness about UDL principles can be easily observed in all outputs, since they addressed both the design process and the practical application. Lesson plans produced by each group included a personal outline which differed from group to group when it embraced information that went beyond the standard institutionalized way to develop a design documentation at school (a formal activity).

The fact that in most lesson plans, sections were included specifically aiming at motivating the use of technology and fully describing the group class as a relational entity highlights how trainee teachers started approaching instructional design as a functional tool that can continuously improve the quality of the teaching/learning process. The generative function of the lesson plan was clearly underlined in outputs which referred to assessment as a formative feedback opportunity for the teacher to "re-design" or "re-modulate" the didactic action (intentionality, significance, resources) according to inputs collected through class observation and not just based on class results.

Both lessons plans and multimedia artefacts showed an insistence on the concept of relationships (teacher-students, student-student) and the roles of the body as a driver to activate and develop more effective communication and, thus, to enrich relationships in the class system. The body is part of the

multimodal representation as enacted codes (Philips, 2020) (sensorimotor codes) that can be additionally used to improve students' understanding and acquisition of a different perspective, "to allow the inclusion of the 'other' in their construction of the world" (Kress, 2020 p. 28).

The trainee teachers' insistence on multimodal codes can be easily seen in artefacts such as online books created by using resources that can be analysed on different levels: (1) student engagement: e.g. the teacher formulated a simplified text (at the linguistic, textual and graphic level) to be inserted in the page accompanied by a drawing made by children and put in a frontal position; and (2) student access: e.g. the use of an oral narration by the teacher that can be optionally activated in the book and that represents an additional comprehension input thanks to paralinguistic aspects (tone, intonation, pause and speech speed).

Trainee teachers demonstrated their taking into account of UDL principles by designing and creating resources and activities whose main objective was not to be "perfect" from a technical point of view but instead to be fully accessible in their format, graphical layout and content organization. The discussions and perspectives shown by exchanges during the group work and collective sessions highlighted an enhanced professional posture, where each step and every aspect of the design process underwent a critical analysis that, when necessary, brought about a remodulation of the actions taken.

4. Conclusions

Collected data in the three editions showed strong consistency in the participants' feedback about the relevance of being involved in collaborative, hands-on activities where they could interact and take advantage of their diverse backgrounds (competence in ICT; work experience, etc.) and have an active role in testing affordances provided by the technologies included in the proposed tasks. The shift from a face-to-face to an online course format did not affect the participants' level of engagement, but it did require a deeper effort in the formative feedback process. Both individual and group inputs, offered by the course professor in the direction of a feed-forward objective (Price et al., 2011), were considered as valuable and necessary recursive steps to be developed through different learning formats in both space and time.

The balance between synchronous and asynchronous didactic actions was a key aspect not only in reference to feedback but also for fostering reflection opportunities. The online environments were not considered as merely a forced alternative to face-to-face instruction but instead an opportunity to work within an enhanced learning process where trainee teachers could deeply experience,

in an immersive dimension, the impact that technologies can have on the didactic relation and action.

The final step, which required trainees to frame the creation and use of a multimedia artefact in a lesson plan, showed the acquired awareness by the trainee teachers of the instructional design relevance; the lesson plan was, in fact, dealt with as an empowering tool and not just as a formal bureaucratic task to accomplish as a mere duty.

The discussions that took place at the end of the final outputs presentation highlighted a newly conquered attitude towards the design process; trainee teachers addressed the need to reach an appropriate level of competence to design and produce flexible learning paths, and this openly communicated perception was reinforced and validated by the effort made in the written lesson plans, where flexibility can be tracked in three ways: in the attention placed on different UDL learning networks (Rose & Strangman, 2007) present in the objective section, in the management of the proposed activities and in the strategic support of technologies.

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