

# Instructional planning and new technologies in teacher education: the initial phase of a research project

## *Progettazione didattica e nuove tecnologie nella formazione iniziale degli insegnanti: prima fase di un progetto di ricerca*

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**HOW TO CITE** Messina, L., De Rossi, M., Tabone, S., & Tonegato, P. (2018). Instructional planning and new technologies in teacher education: the initial phase of a research project. *Italian Journal of Educational Technology*, 26(1), 56-70. doi: 10.17471/2499-4324/992

**ABSTRACT** The purpose of this work is to present the initial phase of a research project focused on the integration of technologies in the education of kindergarten and primary school student teachers through instructional planning. Firstly, we illustrate a tool designed for planning integrated learning units and describe the training path in which it was used. Secondly, we report the results of a preliminary study conducted with 96 students attending a university course that investigates two personal traits considered as prerequisites for using the tool: perceived proficiency in technology use, and opinions on the importance of each constituent element of the tool. With regard to both traits, some statistically significant variations emerged. The results obtained are an encouragement to continue the research project to verify whether the tool could be suitable to help student teachers develop an integrated planning procedure.

**KEYWORDS** Teacher education; Instructional planning; Technology integration; Perceived proficiency in technology use; Opinions on instructional planning elements.

**SOMMARIO** Lo scopo di questo lavoro è presentare la fase di avvio di un progetto di ricerca finalizzato a integrare le tecnologie nella formazione dei futuri insegnanti della scuola dell'infanzia e primaria attraverso la progettazione didattica. Dapprima, viene illustrato uno strumento elaborato per progettare unità di apprendimento integrate e descritto il percorso formativo in cui è stato inserito. Successivamente, vengono presentati i risultati di uno studio preliminare, svolto con 96 studenti frequentanti un corso universitario, finalizzato a indagare due dimensioni ritenute prerequisiti per l'utilizzo dello strumento: padronanza delle tecnologie e opinioni sull'importanza degli elementi costitutivi dello strumento di progettazione didattica. I risultati mostrano alcune variazioni statisticamente significative per entrambe le dimensioni indagate e incoraggiano a proseguire la ricerca per verificare se lo strumento sia adatto a

sviluppare negli insegnanti una procedura integrata di progettazione didattica.

**PAROLE CHIAVE** Formazione iniziale degli insegnanti; Progettazione didattica; Integrazione delle tecnologie; Capacità d'uso percepita delle tecnologie; Opinioni sugli elementi della progettazione didattica.

## 1. INTRODUCTION

The “permanent revolution” in education, already professed by Bruner (1962) in the 60s, is nowadays a fact of life linked in large part, though not exclusively, with the rapid development of technology. This revolution is forcing scientific research as well as educational policies to commit themselves to the identification of strategies aimed at “keeping pace” with this phenomenon, primarily in the field of technology integration in teacher education and in school practices (for a review, see Messina & De Rossi, 2015).

In international research on the introduction of technology in education, there are various theoretical models aimed at integrating technology into teacher knowledge (e.g., Angeli & Valanides, 2009; Mishra & Koehler, 2006; Zhao, 2003) and practical proposals for pre-service and in-service education and training (Lawless & Pellegrino, 2007).

At the same time, research highlights a number of obstacles for technology integration: first-order barriers, like political, structural, organizational and managerial obstacles (Kay, 2006); and “second-order barriers” (Ertmer, 1999), corresponding to teachers’ personal traits such as perceived proficiency, beliefs, attitude and self-efficacy, which can be considered also as predictors of ICT integration (Sang, Valcke, van Braak, & Tondeur, 2010; for a review, see Messina & Tabone, 2015b).

In line with research aimed at enacting theoretical models offering pre-service teachers authentic tasks (Tondeur et al., 2012), we designed a multi-year research project focused on the integration of technology in the training of future kindergarten and primary school teachers through instructional planning (IP). The ultimate and focal goal of the research project is to verify whether it is possible to develop an integrated procedure for IP and if, once internalized, it could be transferred to the different disciplinary areas that student teachers encounter in the course of their studies.

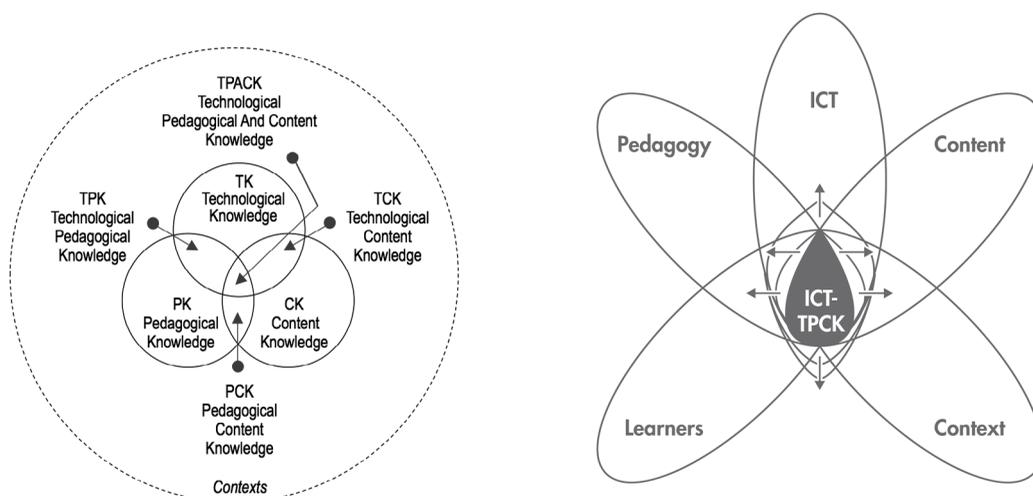
The work presented here is related to the first phase of the research project, which consisted in (a) the design and use of a tool to plan learning units and (b) a preliminary study of two personal traits – technology proficiency and opinions about the importance of IP elements – to examine whether these might constitute barriers to the achievement of the ultimate goal of the research project. In brief, this work tackles the issue of technological integration from a particular perspective that highlights, on the one hand, the procedural aspect – meant in a cognitive sense – that is intrinsic to IP, and, on the other, some beliefs usually overlooked but which, in our opinion, could determine teachers’ educational choices.

## 2. THEORETICAL BACKGROUND

During the last decade, TPCK (Technological Pedagogical Content Knowledge), a theoretical model based on Shulman’s (1986) Pedagogical Content Knowledge (PCK) construct, has become increasingly central to studies on teacher education. This model has been proposed by different scholars (Angeli & Valanides, 2005, 2009; Koehler & Mishra, 2005a; Mishra & Koehler, 2006) and has been amply used as a guide for technology integration in teacher education and training.

Mishra and Koehler’s TPCK (2006), later named TPACK (Thompson & Mishra, 2007), which is shown in Figure 1, is an *integrative* model (Angeli, 2015), as it considers three basic knowledge forms – CK-Content

Knowledge, PK-Pedagogical Knowledge and TK-Technological Knowledge – as well as further knowledge forms derived from integration of these three: Pedagogical Content Knowledge (PCK), as conceived by Shulman (1986, 1987); Technological Content Knowledge (TCK); Technological Pedagogical Knowledge (TPK); and finally Technological Pedagogical And Content Knowledge (TPACK). Empirical research on this model focuses mainly on the measurement of the different knowledge forms derived from the basic ones (e.g., Schmidt et al., 2009), even though there is some theoretical difficulty in defining the conceptual boundaries between them (Graham, 2011; Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2012). Adopting another perspective, Angeli and Valanides (2005, 2009) propose a *transformative* model – ICT-TPCK (Figure 1) – that considers five distinct knowledge forms: Content Knowledge, ICT Knowledge, Pedagogical Knowledge, Knowledge of Learners, and Knowledge of Educational Context. Empirical research using this model seems to conclude that TPCK is a distinct body of knowledge that goes beyond the mere integration of its constituent knowledge forms; rather, it derives from the transformation of these knowledge forms and requires the development of specific competences (Angeli, 2015).



**Figure 1.** On the left, TPACK (Koehler & Mishra, 2009); on the right, ICT-TPCK (Angeli & Valanides, 2009).

It is beyond the scope of this paper to make a detailed comparison of these two models, which have proved equally effective (Angeli & Valanides, 2015; Herring, Koehler, & Mishra, 2016). Though it might appear somewhat simplistic, from now on we will refer to both models with the acronym TPCK, as originally proposed by Mishra and Koehler (2006).

Several scholars have dealt with how to operationalize TPCK, providing guidance for teacher education. For example, Koehler and Mishra (2005b) suggested the training approach *learning by design*; Angeli and Valanides (2013) proposed a “situative methodology” called *technology mapping*; Harris and Hofer (2009) proposed an operationalization of TPCK based on “activity types”, i.e. the different *learning activities* in which teachers intend to engage students, thus introducing an extremely significant element often neglected in IP. Moreover, they consider another aspect which is often omitted during planning (though it is equally, if not more, important), one that can be called *forms of knowledge*. In this category, the different activity types are subsumed and range from knowledge building to expression of knowledge, the knowledge being convergent or divergent, product- or process-oriented and related both to verbal language as well as to other

languages (Harris & Hofer, 2009).

With regard to this last aspect, the proposal made by Harris and Hofer (2009) could be integrated with the theoretical contributions of Cope and Kalantzis (2000, 2009), concerning the *multimodality* of meaning-making. This consists in the use of different forms of language, which they categorise as linguistic, visual, audio, tactile, gestural, and spatial modes of meaning, increasingly integrated in everyday media and cultural practices. In a certain sense, this is the perspective also adopted by Angeli and Valanides (2009), who consider the representations that technology affordances make possible, but see them as means to transform content into representations that can actually foster or augment students' conceptual understanding.

In line with these theoretical considerations, we believe that, together with forms of knowledge that are developed in students through learning activities, modalities of knowledge representation should be contemplated within IP. In other words, we think that the process of teacher training should enable student teachers to learn to design teaching actions taking into account not only the forms of knowledge foreseen in the TPCK, but also the "mental activities" of students, which are greatly influenced by the multimedia languages of new technologies that constantly surround them (Messina & Tabone, 2015a).

In the research aimed at operationalizing TPCK, explicit reference is made to instructional planning (Harris & Hofer, 2009) or to instructional design (Angeli & Valanides, 2009). Angeli and Valanides (2013), for example, refer to specific competences teachers need for developing their "transformative knowledge", distinguishing five types that also correspond to elements of IP.

IP is a crucial part of teachers' professionalism and initial training (Laurillard, 2012; Yinger, 1980). Furthermore, it is the ideal ground to put teachers' knowledge in action (Harris & Hofer, 2009), as it allows them to transform theories they are learning into teaching paths (John, 2006).

Indeed, like any aspect in the development of teaching expertise, learning how to design a technology-enhanced lesson involves many other variables in addition to the theoretical-operative knowledge of its basic elements, including teachers' proficiency in using technologies.

Technology proficiency – which presupposes «*teachers' technical competence and confidence in respect to using technology*» (Instefjord & Munthe, 2016, p. 80) – is a basic requirement for technological integration (Butler & Sellbom, 2002) and it appears as a «*necessary 'stepping stone' toward technology integration*» (Anderson & Maninger, 2007, p. 152), though intertwined with personal traits like beliefs (Voogt et al., 2012).

Belief systems consist of «*an eclectic mix of rules of thumb, generalizations, opinions, values, and expectations grouped in a more or less structured way*» (Hermans, Tondeur, van Braak, & Valcke, 2008, p. 1500). Research shows that teachers are likely to plan and implement practices with technologies that reflect their beliefs and, conversely, teacher beliefs can become a second-order barrier to the integration of ICT in teaching (Ertmer, 2005). In the literature it is difficult to find a clear distinction between beliefs and opinions, the latter being usually comprised in the former (Hermans et al., 2008). It is also rare to find research on beliefs or opinions about IP, except when this is considered as a unitary concept or as a general ability (e.g., Brown & Wendel, 1993; Dinham, 1989).

Several studies consider IP as an authentic and situated pedagogical task useful for teaching pre-service teachers how to integrate technology (Lee & Lee, 2014). However, to our knowledge, no research has been conducted that investigates student teachers' opinions on the importance of IP's constituent elements, even though it is reasonable to suppose that these play an important role in planning decisions and in the relative weight teachers attribute to each element. In our study, opinions on IP's elements are particularly relevant, since IP is the nucleus on which the student teachers' education and technology integration are based. For this reason, we considered it appropriate to explore students' technology proficiency and their opinions on the constitutive elements of the planning tool we designed.

Hereinafter, we will report the steps of the first phase of the research project, consisting in the development of

a tool for IP, the organization of the course in which the tool was used, and in a preliminary investigation into two of the main personal traits implied in its use.

### 3. THE PLANNING TOOL

In line with the theoretical perspectives outlined above and the Italian regulation in force, we gradually devised a training tool that should help student teachers develop an integrated procedure for the planning of learning units and paths or, in other terms, an integrated procedural framework (Messina, 2015; Messina & Tabone, 2015a; Messina, De Rossi, Tabone, & Tonegato, 2016, 2017).

The Italian regulation in force – “National Recommendations for the curriculum in pre-primary and first cycle education” (MIUR-Ministry of Education, 2012) – focuses curriculum organization on four pillars:

1. *content*, referred to fields of experience and subjects<sup>1</sup>;
2. *competency goals*, meant as a guide to orient educational actions and as criteria to assess expected competency;
3. *learning aims*, through which *knowledge* and *skills* essential to the achievement of competency goals must be identified;
4. *assessment and evaluation*.

Moreover, the regulation cites other elements for curriculum organization, among which the *context*, considered in its broad meaning, including *time* and *students’* specificities.

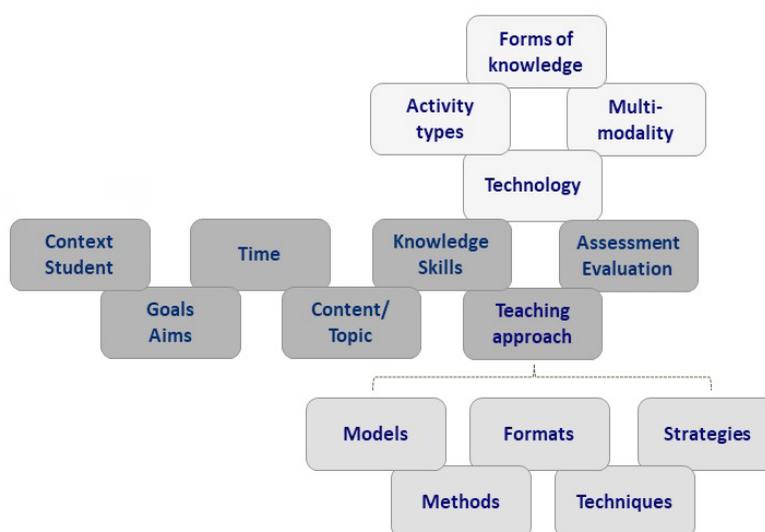
Frequent references are made to two more elements, even if they are not identified as such:

1. *teaching methods*, mostly cited in treating disciplinary areas; and
2. *technology*, mentioned several times in the document and generically considered as components of daily life and school experience, but also included among the competences students have to achieve at the end of their education.

Our training tool supports these last two elements, which should be considered the pillars of IP in the same way as those proposed by the MIUR. The first, *teaching methods*, which we preferred to call *teaching approach*, is a critical issue for teachers, who need to fully understand its constitutive elements, distinguishing methods from techniques, lesson formats from strategies, and so on (De Rossi, 2015). The second, *technology*, is considered not only as a kind of knowledge teachers should connect with their pedagogical and content knowledge, but also from the students’ perspective. More precisely, the training tool requires future teachers to think, during lesson planning, about (a) the actual actions in which they intend to engage their students (write an essay, create a picture, build a model, etc.), (b) the forms of knowledge implied in these actions (knowledge building, convergent knowledge expression, visual divergent knowledge expression, etc.) (Harris & Hofer, 2009), and (c) the forms of knowledge representation (Cope & Kalantzis, 2000) as modes of meaning-making (verbal, iconic, audio, etc.) through which knowledge is structured.

The resulting IP scheme, as shown in Figure 2, includes eleven elements – one of which is divided into five factors – that future teachers should learn to cope with both separately and as a whole, without losing sight of the coherence between them: seven “classic” elements, i.e., *context* and *students*, *goals* and *aims*, *time*, *content*, *knowledge* and *skills*, *teaching approach*, and *assessment and evaluation*; the five factors that divide the teaching approach element into its often tacit components, and which we indicate as “highlighting the implicit”, i.e., *models*, *methods*, *formats*, *techniques*, and *strategies*; plus four “innovative” elements, namely *technology* (as ICT), *activity types*, *forms of knowledge*, and *multimodality* of knowledge representation.

<sup>1</sup> We refer to the Italian regulation in force, which distinguishes between “fields of experience” (campi di esperienza) related to preschool curricular activities and the “subjects” taught in primary school.



**Figure 2.** Classic elements (centre), factors highlighting the implicit (bottom) and innovative elements for the integrated planning of learning units or paths (top).

### 3.1. INTERVENTION

The IP scheme presented in Figure 2 was the nucleus of the course called *Teaching Methodologies and Educational Technology* that the authors held during the second year of the master degree in Primary Teacher Education at the University of Padova.

The course consisted of two theory modules, dealing with a number of different theories, including those mentioned above, and related workshops in which the theories were put into action under the guidance of trained tutors, according to the scheme shown in Figure 2<sup>2</sup>.

Once it was checked that the students enrolled in the course had attended the General Didactics teaching in the first year of their degree course, and so they were familiar with the classic elements of IP, teaching methodologies were presented in greater detail as the first theory module, with particular attention paid to five theoretical constructs: models, methods, formats, techniques and strategies. In the subsequent first workshop, the students were divided into groups and sub-groups, each of which focused on a specific field of experience or a given subject. The sub-groups used either a paper or an online version of the IP scheme in which the elements in Figure 2 were presented in a linear order (Messina, 2015). Their task was to plan a learning unit considering the seven classic elements, together with the five factors indicated in the diagram of the *teaching approach*, dealt with during the lessons.

The second module addressed models for technology integration, approaches for the operationalization of such models, assessment and evaluation of - and with - technologies. In the same lesson period, students worked in the same groups as in the first workshops and used the Moodle platform, which offered them a group forum where they were called upon to carry out three activities. First, they individually explored software and educational resources on the Internet and, using a data sheet with predefined indicators

<sup>2</sup> All four authors of this article were involved in the course: Marina De Rossi led the Teaching Methodologies module; Laura Messina led the Educational Technology module; Pietro Tonegato was responsible for the workshops, as supervisor; and Sara Tabone was responsible for the online questionnaire, and the collection and processing of the resulting data.

(Messina, Tabone, & Tonegato, 2015), they made a note of preferred technologies related to the field of experience and subject that were concerned with, and possibly also to the content or topic chosen for the Teaching Methodologies workshop. Second, they discussed the software and resources that each had found, and their possible use in the context of the subject or field of experience they had chosen. Third, they selected the software and resources that they considered the most effective for teaching in that particular subject or field, distributed evenly between pre-school and primary school levels. After this, they inserted the selected resources into a “glossary”, which was then used in the Educational Technology workshop. In this workshop, the students, divided into the same sub-groups as before, again took up the planning they had been working on during the first workshop and tried to connect the four innovative elements – technology, learning activity types, forms of knowledge, modalities of knowledge representation – with the classic elements, having the freedom to change in part or even entirely what they had designed in the first workshop. Finally, they prepared a digital presentation of the learning unit they had planned and showed it to the whole group.

#### **4. PRELIMINARY STUDY**

Parallel to the enactment of the course, we considered it appropriate to perform a study of two of the main personal traits implied in the use of the planning tool: perceived proficiency in technology use and the value attributed to the elements of IP (Figure 2). The aim of the study was to investigate the initial configuration of these dimensions and to verify whether, by the end of the course, any modifications had taken place. In other respects, the purpose of the study was to obtain feedback on the suitability of the course, even if indirectly, and on the feasibility of the planned subsequent research phases, since the two investigated traits could prove to be important barriers to the ultimate goal of the research, that is helping students to develop a technologically-integrated procedure of instructional planning.

##### **4.1. Participants**

The participants were 96 students who had attended a minimum of 70% of the hours of the course of Teaching Methodologies and Educational Technology. Their ages ranged between 19 and 36, the mean age being 21. Of these, 9.4% were already graduates, while the remaining 90.6% had a high school diploma. 10.4% of the participants worked, but only 5.2% had had some occasional teaching experience and 1% continuative teaching experience. 6.3% reported that they had never used technologies as students, while 4.2% had used them mainly at primary school, 16.6% mainly at lower secondary school, and 72.9% mainly at upper secondary school.

##### **4.2. Instruments**

At the beginning and at the end of the teaching course, the same structured questionnaire consisting of three sections was administered. Section 1 collected socio-demographic data, information regarding the frequency of lesson attendance and responses to two questions that were necessary to correlate the initial and final questionnaires but did not by any means nullify the anonymity of the responding student. Section 2 contained 22 items, surveying perceived proficiency in technology use on a four-point scale. The scale was adapted from Georgina and Hosford (2009) and measures students' self-assessed proficiency in the use of the single technologies listed: 1 = no proficiency; 2 = low proficiency; 3 = adequate proficiency; 4 = high proficiency. This scale was used in earlier research (Messina & Tabone, 2013, 2014), both with student teachers and with university professors. Prior to its use, the scale was translated and discussed with

one of its authors, and subsequently administered to a group of students not participating in the research. Section 3 contained the 11 items corresponding to the elements of the IP scheme in Figure 2, randomly presented. The scale surveyed students' opinions about the importance of each element for instructional planning on a four-point scale: 1 = not important; 2 = little important; 3 = important; 4 = very important. This scale was used for the first time in this research. The scale had been previously shared with the tutors of the master degree course for a common definition of the items, many of which correspond to the planning elements indicated by the Italian regulation in force, and subsequently administered to a group of students not participating in the research.

### **4.3. Procedure and data analysis**

The questionnaire was made available on the course page of the Moodle platform for completion online. The compilation took place at the beginning and at the end of the course.

The data obtained from the questionnaire were analysed using the SPSS.23 software. As regards the scales in Sections 2 and 3, descriptive analysis and paired-samples T-test analysis were carried out to find statistically significant variations occurring between the beginning and the end of the course.

## **5. RESULTS**

The results concern the comparison of data from the first and second questionnaire administration pertaining to the personal traits under investigation. Tables 1 and 2 show mean, standard deviation, t values and p values referred to the first (Pre) and the second (Post) questionnaire administration. Statistical significance was set at  $p < .05$ .

With respect to perceived proficiency in the use of technologies (Table 1), the reliability of the scale appears adequate according both to Cronbach's alpha coefficient in the first ( $\alpha=.855$ ,  $n=22$ ) and in the second ( $\alpha=.873$ ,  $n=22$ ) questionnaire administration, and to a significant test-retest correlation ( $r=.682$ ,  $p=.000$ ).

The mean of the 22 items composing the scale was used to create a synthetic index for the first ( $M=2.62$ ,  $SD=.374$ ) and the second ( $M=2.80$ ,  $SD=.402$ ) administration. The paired-samples T-test analysis showed significant variations in students' proficiency at the beginning and after the course ( $t=-5.472$ ,  $p=.000$ ). To be more specific, the students judged more positively their ability in using browsers, creating and managing databases, producing and sharing videos, creating presentations, installing or removing software, transferring data among devices, using specific educational software and apps for teaching, and using the interactive whiteboard (IWB).

These modifications concern some of the main skills addressed during the second theoretical module through the online activities and in the workshop, where students could explore different technologies and their educational affordances, coming to terms with the use of browsers, software, IWBs, databases and presentations, often for the first time in their careers.

<b>Section 2. Perceived proficiency in technology use</b>	<b>Pre (n=96)</b>	<b>Post (n=96)</b>		
<b>Items</b>	<b>Mean ± SD</b>		<b>t</b>	<b>p</b>
B1. use e-mail	3.74 ± .441	3.82 ± .384	-1.723	.088
B2. use browsers	3.46 ± .560	3.64 ± .526	-3.088	.003 *
B3. use search engines	3.63 ± .528	3.61 ± .510	.199	.843
B4. use word processing programme	3.25 ± .580	3.30 ± .634	-.744	.459
B5. use spreadsheets	2.53 ± .680	2.64 ± .682	-1.636	.105
B6. create and manage databases	1.47 ± .542	2.64 ± .682	-15.256	.000 *
B7. use photo-retouch software	1.81 ± .744	1.88 ± .757	-.948	.345
B8. take and share photos	3.15 ± .882	3.14 ± .902	.152	.880
B9. produce and share videos	2.24 ± 1.003	2.53 ± 1.066	-2.939	.004 *
B10. create presentations	3.02 ± .767	3.23 ± .640	-2.616	.010 *
B11. use editing software	1.97 ± .978	2.11 ± .961	-1.799	.075
B12. install and remove software	2.27 ± 1.061	2.66 ± .993	-3.998	.000 *
B13. install or remove app on tablet or smartphone	3.48 ± .696	3.49 ± .680	-.159	.874
B14. transfer data from device to device	3.19 ± .685	3.38 ± .653	-2.380	.019 *
B15. use educational software for teaching	1.39 ± .605	2.02 ± .767	-7.043	.000 *
B16. use specific app for teaching	1.24 ± .453	1.96 ± .807	-8.487	.000 *
B17. use an IWB	2.15 ± .929	2.36 ± .848	-2.359	.020 *
B18. conduct bibliographic research online	2.42 ± .829	2.57 ± .778	-1.856	.067
B19. use forum, wiki, chat	2.83 ± .763	2.90 ± .747	-.815	.417
B20. manage personal webpages or blog	2.05 ± .731	2.09 ± .834	-.429	.669
B21. use social networks	3.44 ± .779	3.51 ± .768	-1.407	.163
B22. use social networking for learning	3.03 ± .900	3.07 ± .920	-.440	.661

**Table 1.** Perceived proficiency in technology use.

With respect to Section 3 of the questionnaire regarding students' opinions on the importance of IP elements (Table 2), the reliability of the scale appears adequate in both measurements (first:  $\alpha=.842$ ,  $n=11$ ; second:  $\alpha=.910$ ,  $n=11$ ) and the test-retest correlation is significant too ( $r=.443$ ,  $p=.000$ ).

Section 3. Opinions on the importance of IP elements	Pre (n=96)	Post (n=96)		
Item	Mean $\pm$ SD		t	p
C1. teaching approach	3.81 $\pm$ .443	3.74 $\pm$ .464	1.222	.225
C2. knowledge and skills	3.81 $\pm$ .392	3.73 $\pm$ .447	1.648	.103
C3. content or topic to be taught	3.69 $\pm$ .466	3.72 $\pm$ .475	-.505	.615
C4. context and students	3.88 $\pm$ .363	3.83 $\pm$ .427	.893	.374
C5. forms of knowledge (that students can develop through learning activities)	3.48 $\pm$ .523	3.63 $\pm$ .548	-2.054	.043 *
C6. modalities of knowledge representation (that students can use during learning activities)	3.55 $\pm$ .578	3.64 $\pm$ .545	-1.070	.287
C7. assessment and evaluation	3.35 $\pm$ .740	3.60 $\pm$ .571	-3.376	.001 *
C8. technology	3.29 $\pm$ .648	3.45 $\pm$ .596	-2.056	.042 *
C9. time schedule	3.64 $\pm$ .545	3.63 $\pm$ .585	.142	.887
C10. learning activity types in which students will be engaged	3.63 $\pm$ .508	3.74 $\pm$ .441	-2.078	.040 *
C11. competence aims and learning goals	3.72 $\pm$ .496	3.74 $\pm$ .528	-.406	.685

**Table 2.** Opinions on the importance of IP elements.

The mean of the 11 item scores was used to create a synthetic index for the first ( $M=3.62$ ,  $SD=.329$ ) and the second ( $M=3.68$ ,  $SD=.374$ ) questionnaire administration. The paired-samples T-test analysis did not show significant variations in students' opinions on the importance of IP elements between the beginning and the end of the course ( $t=-1.418$ ,  $p=.159$ ). However, as illustrated in Table 2, a paired-samples T-test analysis for each item shows that by the end of the course students appear to attribute greater importance to *forms of knowledge*, *assessment and evaluation*, *technology*, and *learning activity types* for their pupils. Essentially, the elements in which we found significant variations are related, in three cases, to the “innovative” elements presented theoretically during the lectures and operationally in the dedicated workshop (forms of knowledge, technology, and learning activity types). In the fourth case, a significant variation is linked to the assessment and evaluation element, specifically addressed during the second theoretical module, with implications also about the role of technology. On the other hand, no significant variation was found regarding the *modalities of knowledge representation* (item C6), the fourth “innovative” element of the IP scheme proposed to the students both theoretically and operatively.

## 6. DISCUSSION

The results of the study reveal significant variations regarding some aspects of the two dimensions being

investigated. As regard opinions on the importance of IP elements, it seems that the students were mainly attracted by the innovative elements of the project, but it should be pointed out that opinions about the “classical” elements appeared positive from the beginning of the course. The non-statistical significance of one of the four “innovative” elements – *modalities of knowledge representation* – can be interpreted in a number of ways, for example by the theoretical distance between the approach of Cope and Kalantzis (2000) and the models centred on the TPCCK. Another explanation might be related to the “redundancy” of the construct, given its similarity with the construct of affordance, that is inextricably connected with technology (Angeli & Valanides, 2013).

As regards the results about technology proficiency, when compared with the unequivocal modifications that occurred for several of the items considered, it is worth observing that the mean scores of various items are not very high. Taking into account that proficiency is the result of a non-linear process, which demands a multifaceted approach (Finger et al., 2013), this result raises the question whether it might be convenient to undertake specific actions to enhance proficiency (Abbitt & Klett, 2007) or if a progressive and deeper familiarity with the planning tool – which was used by our students to plan a single learning unit – could also improve technology proficiency, as the research shows with regard to other personal traits (Lee & Lee, 2014). On the other hand, analysis of the learning units planned by the students, although not systematic (for an example, see Messina, De Rossi, Calogero, Tabone, & Tonegato, 2017), shows that students were able to connect in a coherent and meaningful way all the elements considered, though the workshop tutors’ reports suggest it does not seem an easy task. Finally, even if the results of the study on the two personal traits are modest, they do not appear as barriers, and encourage us to pursue the focal goal of the research project, which maintains its relevance from a formative standpoint.

## 7. CONCLUSIONS AND FUTURE DEVELOPMENTS

This work presents the first phase of a research project whose focal goal was to provide student teachers with a tool which could allow them to develop a procedure for IP that combines technological knowledge not only with pedagogical and disciplinary knowledge, but also with the other basic areas of knowledge they should master when planning teaching units, providing the opportunity to incorporate into their planning knowledge also the concrete and mental actions that their plan would require for their target students.

Although the explorative nature of this study implies certain limits, we believe that it contributes to the ongoing discussion on how to effectively design teacher training paths for technology integration (Angeli & Valanides, 2013; Harris & Hofer, 2016), by strengthening the focus on the procedural dimension – from a cognitive viewpoint – intrinsic to IP.

Students’ openness to the “innovative” planning elements is an encouraging sign to continue research into the suitability of the training tool to develop a flexible procedural framework that is also adaptable to IP in different disciplinary fields. It is well documented that it is essential to train student teachers through authentic tasks that combine theory and practice (Tondeur et al., 2012), IP being one of these despite the fact that it may appear in some ways distant from real teaching practices (Lee & Lee, 2014). The challenge is to foster interaction between the pedagogical training and disciplinary-area training that students undertake in their studies, which should lead to the development of specialised knowledge. In this sense, the training tool we devised, if proven effective, could be proposed to university professors of those disciplines to be nurtured in kindergarten and taught in primary schools, verifying whether it may be effective for the integration of pedagogical, technological and planning knowledge within specific disciplinary areas.

With this in mind, we plan to develop the research in several directions: to expand the study, adopting, alongside the quantitative measurement, qualitative instruments such as video recording of workshops,

which would enable us to identify the planning procedural framework that students use and which should emerge as they are thinking aloud in a group; to interview students about their planning processes; and to systematically analyse the learning units planned by small groups, evaluating their internal coherence and instructional significance.

Lastly, in the next phase of research we will seek to involve disciplinary professors from the Primary Teacher Education course, by proposing to verify in parallel the efficacy of the IP tool in specific subjects or fields of experience, in which, ultimately, technology should be integrated to guarantee the full professional development of future teachers.

## 8. ACKNOWLEDGEMENTS

This article has been planned and developed jointly by all the authors, who have made an equal contribution to the manuscript.

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