Digital Technologies as a Pedagogical Resource and Their Integration Into Pre-service Teacher Training in Chile

Tecnologías digitales como recurso pedagógico y su integración curricular en la formación inicial docente en Chile

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Abstract

The objective of this study was to characterize the modalities of integration of digital technologies into Chilean initial teacher training and to identify the variables associated with the adoption of a particular modality, based on the study programs of all Elementary and Secondary Pedagogy programs currently admitting students. A content analysis of the information available from all the elementary and secondary pedagogy programs, informed by the Ministry of Education of Chile (n = 225), was conducted in order to identify ICT content in the curriculum and the graduate profiles. We found that there were four modalities of integration: only in graduate profiles (16%), only in subjects (26.2%), in profiles and subjects (22.7%), and no integration (35.1%). We also found that these profiles were distributed homogenously, without differentiation in terms of tuition fees, years of accreditation, proportion of lecturers with a doctorate, specialty (elementary or secondary education), membership of the Council of Rectors of Chilean Universities, the ratio of computers to students, and the proportion of full-time lecturers. It was only possible to identify a significant difference by geographical location, where the north of the country shows a significantly higher proportion of non-integration. These results indicate that a high proportion of study programs do not integrate ICT at all, even at an introductory level, which, in the light of the discussion on public ICT policy in schools, can be interpreted as an inadequate starting point for the initiation of plans that require both advanced ICT skills and the development of skills for implementation in the classroom.

Keywords: curriculum, ICT, initial teacher training, pedagogy, teaching quality.

Resumen

Los objetivos del artículo fueron caracterizar las modalidades de integración de tecnologías digitales en la formación inicial docente chilena, e identificar variables asociadas a la adopción de una modalidad particular, a partir de los planes de estudio de la totalidad de las carreras de Pedagogía Básica y Media con admisión vigente, informadas por el Ministerio de Educación de Chile (*n* = 225), para identificar contenidos TIC en las mallas de estudio y los perfiles de egreso. Como resultado se obtuvieron cuatro modalidades de integración: solo en perfiles de egreso (16%); solo en asignaturas (26,2%); en perfiles y asignaturas (22,7%); y no integración (35,1%). Estos perfiles se distribuyeron de manera homogénea, sin diferenciaciones entre las universidades por costo de arancel, años de acreditación, proporción de profesores con doctorado, mención (Educación Básica o Media), pertenencia al Consejo de Rectores de las Universidades Chilenas, ratio de computadores por estudiante y proporción de profesores con jornada completa. Solo se identificó una diferencia significativa por ubicación geográfica, donde la zona norte muestra una proporción significativamente más alta de no integración. Los resultados evidencian que una alta proporción de planes de estudio no integra en absoluto las TIC, ni siquiera a nivel básico introductorio, lo que a la luz de la política pública de TIC en las escuelas puede interpretarse como un punto deficitario para el inicio de planes que requieren competencias TIC avanzadas y el desarrollo de habilidades para la implementación en aula.

Palabras clave: calidad docente, currículo, formación inicial docente, pedagogía, TIC.

Introduction

There is agreement that digital technologies have affected the way in which society is organized, and that includes the economic, social, political, cultural, educational, and personal spheres (Van Deursen & Van Dijk, 2014). Digital technologies have thus become part of the *ecology* of children, adolescents, and adults, being essential in modern life because they present potential for inclusion, emotional development, and the exercise of rights in childhood and adolescence (Lievens, Livingstone, Mclaughlin, O'Neill, & Verdoodt, 2017; Livingstone & Bulger, 2014). In the same vein, there is abundant evidence that digital technologies offer possibilities for school development, both in the area of curriculum implementation—for example in the field of language (Neumann, Finger, & Neumann, 2017) and learning mathematics (Drijvers, 2015)—as well as in school coexistence (Pariente & Perochena, 2013), the development of socio-emotional skills (Avidov-Ungar & Eshet-Alkalai, 2014), the inclusion of minorities (Garcia-Penalvo, 2013), and civic education (Voight & Torney-Purta, 2013), among other themes associated with the development of skills for the 21st century (Pellegrino & Hilton, 2012). This is the reason why the provision of teaching in the school context should take into account aspects such as access to the internet and other digital technologies, the presence of technologies in schools, the increase in the frequency of their use, and the opportunities and risks this poses for students (Amelii, Reyes, & Ríos, 2017; Graafland, 2018; Tapia, 2018). From this point of view, education should consider these new elements and enhance the opportunities they offer and assume them as the social conditions in which the students will develop (Tapia, 2018). Likewise, content is increasingly available and in great abundance, so participation in the so-called "information society" requires the development of skills to search for and interpret this content so that it can be used effectively (Tobón, 2017).

In light of these broad transformations that are being created by digital technologies, also known as information and communication technologies (ICT), and the changes they lead to in the school environment, it is essential to study the relationship between them and initial teacher training (hereinafter ITT), because this stage of professional training creates the foundations on which the teaching practice will be built (Caliskan, Kuz, & Kuzu, 2017; Tondeur, et al., 2012), in addition to being one of the main tools to change the ways in which teaching and learning are done and to improve the quality of education (Tobón, 2017; Tondeur et al., 2012).

In spite of the importance of ITT, the evidence shows that in Chile this stage has significant shortcomings regarding the exercise of the profession (Rodríguez & Castillo, 2014), which has recently led to proposals that ITT must be changed in order to meet academic expectations and achieve the demonstrable pedagogical success of its graduates in the classroom (Bucksworth, 2017), transforming the training curricula, and making the future teacher a dynamic agent, capable of identifying learning needs and designing strategies to address them (Moreno, 2015; Nascimento dos Santos, Moriya Schlünzen, & Junior, 2016). This challenge implies changing the profile and the skills required to carry out teaching work (Moreno, 2015; Tejada & Ruiz, 2016), both of which are aspects linked to a modification of traditional methods of learning and teaching, including the use of new tools for learning—especially ICT (Cabero & Marín, 2014; Moreno, 2015)—and the incorporation of active learning associated with skills for the 21st century (Pellegrino & Hilton, 2012).

In this context, in 2008 the United Nations Educational, Scientific and Cultural Organization, Unesco, proposed a series of ICT competency standards for teachers, which it later updated in 2011, establishing criteria and parameters for ITT in the ICT area, as well as a standardization of the necessary skills for the future. In this regard, Unesco stated that the successful integration of ICT in the classroom would depend, among other factors, on the ability of teachers to structure new learning environments where technologies have a key role, creating classrooms that promote interaction, collaborative learning, and group work (Unesco, 2011), to which various states have responded with policies and institutional reforms in order to integrate such technologies into teaching-learning processes (Ministère de l'Éducation Nationale et de la Jeunesse, MENESR, 2015).

In Chile, the Ministry of Education (Mineduc), through its Center for Education and Technologies (Enlaces), has developed an important policy addressing access in schools (Mineduc, 2011). However, integration in teaching digital practices in ITT is still low (Rizza, 2011). This is particularly relevant, since the evidence suggests that the educational use and the attitudes that teachers have towards the incorporation of ICT into their classroom practices are directly related to their ITT (Toledo & Llorente, 2016; Tondeur et al., 2012). In this regard, Aslan and Zhu (2017) found that the main predictors of the integration of digital technologies in school teaching are pedagogical knowledge, self-perception of digital skills, and having taken subjects related to the use of digital technologies in ITT. As a consequence, several authors have agreed that the adoption of technologies in teaching practice is related to the quantity and quality of ICT subjects taken during ITT (Aydin, Gürol, & Vanderlinde, 2016; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). It is for this reason that numerous academics insist on improving ITT in terms of the knowledge, skills, and attitudes needed to promote student learning in the digital world (Castañeda, Esteve, & Adell, 2018; Hall, Atkins, & Fraser, 2014). In this respect, teachers who have graduated recently should have the knowledge and skills to design and conduct classes that include the use of technologies, in order to bring curricular goals closer to the realities of students (Mouza, Karchmer-Klein, Nandakumar, Ozden, & Hu, 2014). The challenge, therefore, is to have a teaching staff that not only has the resources and pedagogical strategies to teach their subject, but which, at the same time, is capable of using ICT pedagogically in accordance with the level of education, subject, context, and characteristics of the students (Area, 2008; Román, 2010).

In light of this situation, higher education institutions have had to take on the task of adapting their educational offering with specific courses, in order to address the training requirements of new teachers so as to integrate digital technologies into their practice. However, the evidence suggests that teachers do not feel sufficiently prepared to include technology in their classrooms effectively, in spite of the incorporation of these subjects (Tondeur, Pareja, Van Braak, Fisser, & Voogt (2013); Tondeur, Pareja, Van Braak, Voogt, & Prestridge, 2017; Rodríguez & Castillo, 2014). In this respect, the deficiencies that are identified in new teachers' practices are the lack of pedagogical skills in ICT, the difficulty of adapting pedagogical methodologies to the resources available in each educational establishment, and the lack of coordination with other pedagogical actors who have a diverse range of attitudes regarding technology (Tondeur et al., 2013; 2017; González & De Pablos, 2015). Similarly, the evidence shows that recently graduated teachers tend to make little use of technology in their classes, despite showing more advanced digital skills than their peers from previous generations (Tondeur et al., 2017; Ottenbreit-Leftwich et al., 2010).

As a consequence of this, it is therefore necessary to update the information on the integration of ICT into ITT, in order to provide a point of reference to monitor the transformation of the training offering and longitudinally assess the relationship between this training, the evolution of policies, and institutional regulatory frameworks. This will allow us to put into perspective the debate regarding the quality and updating of ITT and its consequences regarding what is expected to be implemented in the school system in terms of skills for the 21st century (Unesco, 2017).

The following research questions have thus been posed:

- What modalities or strategies for integrating ICT content can be found in the study programs of Pedagogy courses in Chile?

- What is the relationship between the modalities or strategies for integrating ICT into ITT and the quality of educational centers, their geographic location, the sustainability of their educational project, and their orientation towards the two levels of training (Elementary and Secondary)?

The study of ITT in Chile

Cisternas (2011) showed how research subjects related to ITT that are addressed in Chile can be separated into three types. The first and most frequent (45%) is comprised of studies related to actors, that is, research focused on the perceptions, antecedents, or performance of Pedagogy students, degree graduates, trainee teachers, and practicing teachers. In second place (39.4%) is research about the devices, that is, the institutionalized mechanisms for the implementation of the training curriculum, such as its design, implementation, initial and intermediate practice, and professional practice. In third and last place are studies about professional knowledge in training (15.2%), which are comprised by research regarding general and specialty pedagogical training.

In this third type, at the level of content specific to ITT, research in Chile has mainly focused on aspects such as the approach to teaching specific subjects, generally from the area of basic general education. In mathematics, Varas et al. (2008) found that the majority of the students (68%) considered that the number of subjects in the discipline that they had in their respective curricula was insufficient, which affected the development of mathematical knowledge and skills. Similarly, a large proportion of the students (79%) thought that the number of subjects on methodologies or didactics of mathematics in their course was insufficient, which would impact their preparation and confidence in teaching the discipline (Varas et al., 2008).

In the area of science education, Cofré et al. (2010) pointed out in their study that although the curricula did have a strong disciplinary component, there were gaps in areas such as science teaching, scientific research, and the nature of scientific knowledge. Indeed, these researchers found that the main difficulty experienced by

practicing science teachers was related to creating an environment conducive to research, rather than mastering the content. This is because although they did have specific science subjects, their didactics were transposable to other disciplines (Cofré et al., 2010).

Finally, in the case of teaching language and communication, Sotomayor, Parodi, Coloma, Ibáñez, and Cavada (2011) found that only 8.2% of the areas of the curriculum corresponded to subjects of this kind and that in those the provision of disciplinary and pedagogical knowledge was combined, which seemed to the students to be insufficient.

The modalities of integrating ICT into ITT

The available evidence shows that in Chile, despite the growth in access to ICT, pedagogical innovation based on ICT is still minimal (C5-Universidad de Chile, 2008; Román, 2004). Indeed, beliefs suggest that it is sufficient merely to have access to computers or the internet to improve student performance, regardless of the training that teachers have in the use of such technologies or, rather, of the generation of significant knowledge through them (Çapuk, 2015; Garrido, Rodríguez, & Silva, 2010).

On the other hand, it has been found that universities often do not have a systematic strategy for including ICT in Pedagogy courses (Garrido et al., 2010). Thus, the inclusion of such technologies in ITT implies reviewing their role in promoting learning and their contribution to a paradigm shift, where there is a move from teaching focused on reproduction and the passivity of students, to one characterized by the production of the students and focused on teacher-student and student-student interaction. In this regard, teacher training solely for the use of technology becomes insufficient and it should be shifted towards training that allows one to function in this new context, promoting learning (Çapuk, 2015; Garrido et al., 2010) and combining it with active learning strategies for developing skills for the 21st century (Pellegrino & Hilton 2012; Unesco, 2017).

In response to this situation, public policy has attempted to promote the incorporation of ICT training into ITT for more than 15 years, which can be seen in guidelines such as the *Marco para la buena enseñanza* (Framework for good teaching) (Mineduc, 2008), *Estándares orientadores para egresados de carreras de Pedagogía en Educación Media* (Guiding standards for graduates of Pedagogy in secondary education) (Mineduc, 2012a), *Estándares orientadores para egresados de carreras de Pedagogía en Educación Básica* (Guiding standards for graduates of Pedagogy in elementary education) (Mineduc, 2012b) and the *Informe preliminar de la Comisión sobre la formación inicial docente* (Preliminary report on the Commission on initial teacher training) (Mineduc, 2005). Despite these efforts, the actual definition of integrating ICT into ITT remains unclear. This contrasts with abundant and recent literature on the integration of ICT into the school curriculum (Fernández de la Iglesia, Fernández Morante, & Cebreiro, 2018; Rivallo & Martín, 2017), in which teachers' mastery of ICT stands out as a differentiating factor (Fernández de la Iglesia et al., 2018; Rivallo & Martín, 2017). The sparse literature that exists on the integration of ICT into ITT points to the collection of specific experiences (e.g. Schwartz & Lladser, 2016) and does not address other potential forms of integration, or the effectiveness that these could have in comparison with other integration strategies. There are few studies that have centered on the modalities of integrating ICT into ITT in Chile and those that have addressed the study programs have identified three modes of integration:

- as a specific subject, which is often instrumental and separate from the rest of the curriculum;
- as a transversal learning resource for didactic use in different subjects; and
- their incorporation by means of the graduate profile (Garrido et al., 2010; Silva, Gros, Garrido, & Rodríguez, 2006).

It should be noted that this classification is used to build a reference framework for the creation of standards in ITT, identifying: operational management and application of software, design of learning environments, link with ICT, critical evaluation of the impact of using ICT in learning, continuous improvement, ethics and values oriented towards legal elements, and the ethical use of resources. Nevertheless, it does not offer a cadastre or baseline regarding the way in which these categories are observed in the educational offering.

According to Silva (2011), a key factor for the adoption of ICT in ITT is "the direct connection between the accreditation process of the degree program involved and its integration into the graduate profile" (p. 18). In this respect, as part of its assessment, the National Accreditation Commission (CNA) considers the incorporation of ICTs in Pedagogy courses to be an indicator of quality, which is observed in criterion 3.d on "Graduate profile". However, this only alludes to the existence of processes that make it possible to account for the current status of the technology in the discipline that one intends to teach. Similarly, criterion 4.e. on the "Study program" addresses the need to generate experiences that promote the acquisition of various skills, including the use of ICT. However, it is considered as a transversal competency, so it does not necessarily require a specific subject. Finally, criterion 8.d on "Infrastructure and resources for learning" requires that sufficient computational materials be available, although it does not mention the uses that should be made of them (CNA, 2015b).

Meanwhile, Law 20,903 establishes that, in order to obtain accreditation for degrees and programs, universities should conduct two assessments, both of a diagnostic nature, regarding ITT in Pedagogy (Center for Improvement, Experimentation, and Pedagogical Research, CPEIP, n.d.): the first at the beginning of the degree course, the results of which should be used create and apply support and remedial mechanisms for recently admitted students. The second involves the *Evaluación nacional diagnóstica para la formación inicial de profesores* (National diagnostic assessment for initial teacher training), for which Mineduc is responsible. This assessment should be carried out at least one year before graduation and is intended to evaluate the quality of graduates so that the higher education institutions establish improvement plans based upon them. Although taking this test is a requirement for a student to graduate, the results have no bearing on their graduation.

As part of the application of this instrument, the assessment examines the pedagogical and disciplinary standards proposed by Mineduc in 2012, among other elements. Of these factors, the management and use of ICT is part of pedagogical standard 4: "Knows how to design and implement teaching-learning strategies appropriate for the learning objectives and in accordance with the context". This standard is broken down into 10 specific expressions, which include:

- "Chooses ICT that enhance the development of teaching in each curricular area, based on criteria such as their contribution to learning and the development of higher-order skills (cognitive, communication, expression, and creation skills).

- Evidence of respectful, ethical, and legal behavior regarding information and use of ICT, considering the right to privacy, intellectual property, copyright, and security of information".

- Uses ICT to support tasks related to the administration and management of their professional practice at the establishment and in the classroom" (Mineduc, 2012a; 2012b).

Method

Sample

A census sample of all the study programs in the country (n = 225) in elementary and secondary education, including specialties, has been obtained from universities and professional institutes in all regions of Chile. To the CNA,

> The study program is a structured explanation that defines the times and the subjects corresponding to the areas that are part of the training process leading to the achievement of a graduate profile among the students of the degree course or program. This normally includes: admission profile, training areas, curriculum, and subject programs (CNA, 2015a, p. 7).

The source for the identification and selection of study programs and programs has been the information published by Mineduc through the portal mifuturo.cl, which contains up-to-date information about the entirety of the higher education offering in Chile. The database for the study was constructed by merging the information in this portal and conducting manual exploration of public data sources. This information was supplemented, adjusted, and validated by consulting all the websites on the plans and programs analyzed, from which all the information was also extracted from the curricula and graduate profiles.

Measurements

Despite the worldwide interest in this topic, in Chile and the rest of Latin America there have been few studies about content related to ICT in ITT and its relationship with the demands imposed by the environment (Tondeur et al., 2017). Various authors agree that the Chilean university system is extremely heterogeneous, both in terms of its structural variables and its offering of study programs, which has certainly been a challenge for this research. In fact, such is the diversity seen in this field that this has given rise to various classifications or taxonomies, in order to simplify the differences and/or identify common patterns for Chilean universities (Brunner, 2009; Brunner et al. 2005; Muñoz & Blanco, 2013; Parada, 2010; Reyes & Rosso, 2012; Torres & Zenteno, 2011). This study does not adhere to any of these forms of classification in particular, but instead attempts to create its own model, using various controls in order to try to identify the variables that could be associated with various modalities of integration of ICT into ITT.

Given that no studies have been identified that examine these modalities of integration, we selected variables that were explored in other research focused on ITT, which were used to characterize universities and their quality. These variables were grouped into a model that separates them into the following categories:

- general characteristics of the programs;
- variables of the modality of integration;
- indicators of the viability of the institutional project;
- indicators of the quality of the institutional project;
- structural indicators of the institutional project.

Table 1 shows the structure of the variables chosen for analysis and their origin:

Table 1. Selection of variables and their origin

	Ávalos (2001)	Pérez-Esparrells, & García (2009)	Brunner et al. (2005)	Brunner (2009)	Garrido et al. (2010)	Parada (2010)	Torres & Zenteno (2011)	Reyes & Rosso (2012)	Muñoz & Blanco (2013)
Indicators of integration of ICT into ITT									
ICT subject in ITT					•				
ICT in graduate profile					•				
General description									
Geographic location			•	•					
Elementary / Secondary ITT	•								
Viability of the institutional project									
Annual enrollment			•	•			•	•	•
Fee			•						
Quality of the institutional project									
Accreditation			•	•			•	•	•
Lecturers with doctorate								•	•
Structural indicators of the institutional project									
Full-time lecturers								•	
N° of computers per student		•							
Membership of CRUCh			•	•		•		•	

Source: Prepared by the authors.

Indicators of integration of ICT into ITT. The integration indicators considered for this study are described below.

- ICT subject. ICT subjects are considered to be those whose description indicates one or more of the following contents: general training in ICT or digital media (Introduction to ICT), ICT training linked to pedagogy in general (ICT in the classroom); ICT training related to the particular subject (Use of ICT for teaching Mathematics), or advanced ICT training aimed at developing advanced digital skills (Programming).

- ICT in the graduate profile. The CNA defines the graduate profile as the "Body of knowledge, skills, and attitudes that the student of the degree course or program will have internalized at the time of their graduation or qualification, and which constitutes the frame of reference for the application

of the criteria of evaluation" (CNA, 2015a, p. 7). In this variable, the presence/absence of ICT content in the study program has been coded through a content analysis that records when there is explicit mention of the training of competencies in the ICT field, using a dictionary of terms.

General characteristics of the programs. The following factors were considered regarding these variables:

- Elementary/secondary ITT. In this case it indicates whether the curriculum corresponds to training for teaching in General Elementary or Secondary Education.

- Geographic location. The geographic location of the establishment at which the study program is taught was coded, differentiating three macro-zones: north, center and south.

Indicators of viability of the institutional project. These elements consider:

- Annual enrollment. This is the number of places that are opened up each year for admission to the first year of a decree course or study program. This was separated into three categories using K-means: high (between 180 and 65), medium (between 62 and 35), and low (between 32 and 10).

- Fee. This is the value of the annual fee for the study program for the 2018 cohort (does not include enrollment fee). This was separated into three categories using K-means: high (between $4,408,181 and $3,130,000 Chilean pesos), medium (between $3,090,400 and $2,355,000 Chilean pesos), and low (between $2,308,134 and $1.379.578 Chilean pesos).

Indicators of the quality of the institutional quality. With respect to these indicators the following was considered:

- Accreditation. This refers to the total years of accreditation of the study program. This was coded into three categories: non-accreditation (0 to 1 year); 2 to 3 years of accreditation, and 4 or more years of accreditation.

- Percentage of lecturers with a doctorate. This refers to the percentage of university lecturers with a doctorate degree and it was coded into three categories: high (67% or more of the lecturers), medium (34% to 66% of the lecturers), and low (0% to 33% of the lecturers).

Structural indicators of the institutional project. Lastly, the following was considered regarding these indicators:

- Full-time lecturers. This refers to the percentage of lecturers at the university who spend 39 or more hours teaching. This was divided into high (67% or more of the lecturers), medium (34% to 66% of the lecturers), and low (0% to 33% of the lecturers).

- Ratio of computers to students. This refers to the number of computers at the university in comparison to the number of students. It was categorized as: high (0.20 or more), medium (0.10-0.19), and low (0.09 or fewer).

- Membership of CRUCH. This refers to whether or not the university belongs to this organization.

Analysis strategies

In order to answer the first question in this study, we combined the options of the presence/absence of ICT content in the graduate profile and presence/absence of ICT subjects in the curriculum, so as to determine the level of integration of ICT into the teacher training in the corresponding degree course. We thus generated four categories of ICT integration: full integration (in the profile and the curriculum); integration only in the graduation profile (in the profile, but not in the curriculum); integration only in the curriculum (in the curriculum, but not in the profile); no integration (absence from the profile and the curriculum).

On the other hand, in order to answer the second question, differences were sought between the modalities of integration and the variables: Elementary/Secondary ITT, geographic location, university/professional institute; membership of CRUCH, type of ICT subject, incorporation of the graduate profile, first-year enrollment, fee; years of accreditation, percentage of lecturers with a doctorate, percentage of full-time lecturers; and computer to student ratio.

Finally, the X^2 and p values of these aspects were recorded in order to show that the relationships between variables were statistically significant in this sample.

Results

Descriptors

The descriptors are shown in Table 2, with their proportion, mean, and deviation indicated, as appropriate. As regards the level of training—elementary and secondary—the majority of the programs correspond to studies to practice in secondary education (80%). With respect to the zone, 28.5% are concentrated in the northern zone, 41.5% in the central zone and 29.9% in the southern zone. With regard to membership of CRUCH, we can see that two thirds of the training in Elementary or Secondary Pedagogy is in institutions that belong to that organization.

As regards the presence of ICT subjects, 48.9% of the study programs have at least one subject of this type. In addition, 44.8% of these are subjects that have a pedagogical orientation or purposes, such as ICT in the Classroom and Integrated Technology in General Basic Education. Some 32% are subjects that involve general training in the use of digital tools, which include the Use of ICT and Digital Literacy. Some 14.3% are specialized subjects, such as Applied Technology for Physical Education and ICT in Teaching Science. Finally, only 8.1% involve advanced subjects, such as Information Modeling and Software Development and Object Oriented Programming.

Table 2. Descriptors

Variable	%
Incorporation of ICT content	
ICT subjects	
ICT subjects/total subjects	1.786
At least one ICT subject	48.9
General	32
Education	44.76
Specialized	14.25
Advanced	8.1
Incorporation in graduate profile	
ICT incorporated	38.67
ICT not incorporated	61.33
General description	
Elementary/Secondary ITT	
Elementary	20
Secondary	80

Geographic location	
Northern zone	28.57
Central zone	41.52
Southern zone	29.91
Viability of institutional project	
First-year enrollment in Pedagogy	
High	44.00
Medium	37.78
Low	18.22
Fee	
High	59.56
Medium	23.56
Low	16.89
Quality of institutional project	
Years of accreditation	
Not accredited	14.22
2 to 3 years	23.11
4 or more years	62.67
Lecturers with doctorate	
High	24.44
Medium	54.67
Low	20.89
Structural indicators	
Full-time lecturers	
High	58.67
Medium	36.89
Low	4.44
PC/student ratio	
High	11.56
Medium	40.00
Low	48.44
Membership of CRUCh	
Member	66.67
Not a member	33.33

Source: Prepared by the authors.

What modalities of integration of ICT content can be found in Pedagogy study programs in Chile?

Four modalities of ICT integration in Pedagogy courses can be identified, in accordance with their incorporation into a subject or into the profile (X^2 = 5.372; p < 0.05). The first is the inclusion of ICT into at least one subject, without mentioning it in the graduate profile, which accounts for 26.2% of the total. Within this modality are study programs such as Pedagogy in English at the Universidad Católica del Norte and Pedagogy in Physical Education at the Universidad Católica de Temuco. Secondly, there are programs that do not include ICT in the subjects, but which do mention ICT in the graduate profile, totaling 16%. These include, for example, the Education programs at the Pontificia Universidad Católica de Chile and Pedagogy in Communication in English Language at the Universidad Austral. In third place are programs that include ICT in both the subjects and the graduate profiles, reaching 22.7% of those taught in 2018. Within this modality, for example, we have Elementary Pedagogy with Specialization in Language and Mathematics at the Universidad de Magallanes and Pedagogy in Secondary Education in Biology and Chemistry at the Universidad de Chile. Lastly, we find that 35.1% of the programs do not include ICT in the subjects and nor do they include ICT training in the graduate profile—described as "non-integration" (Table 3)—which include Elementary Education at Universidad Finis Terrae and Universidad de Viña del Mar. This lack of integration is included within the types of integration because the most relevant findings refer to this group, while at the same time it is assumed that this non-integration is a decision of the study programs and, therefore, this constitutes an alternative in relation to the other three forms of integration.

Table 3. Graduate profile and ICT subjects in study programs

	ICT Subject	No ICT subject
ICT in profile	22.7%	16%
ICT not in profile	26.2%	35.1%

(X2 = 5.372; Pr = 0.014; α = 0.05)

Source: Prepared by the authors.

What are the main differentiating factors regarding the modality of integration of ICT into ITT?

Table 4 shows a summary of the findings for this second question. In the case of the relationship between modalities of ICT integration in study programs by the ITT level (Elementary or Secondary) there are no significant differences (X^2 = 5.30; p > 0.05), while there are significant differences when we analyze them by geographic location (X^2 = 17.56; p <0.05). In the northern zone, the majority of the study programs have two main modalities of integration at an equal frequency (6.25%): the integration of ICT into subjects and the graduate profile, and the integration of ICT only into subjects. In the central zone, integration of ICT into the subjects and the profile is more prevalent (9.38%), followed by integration of ICT solely into the subjects (8.48%). Finally, in the southern zone, most of the plans examined only have ICT integration in the subjects (11.61%), followed by integration of ICT into the subjects and the graduate profile (6.70%).

As regards the type of educational institution, one relevant finding is that the modalities of integration are not significantly different based on whether or not they are members of the CRUCH organization (X^2 = 0.82; p > 0.05).

As regards sustainability indicators, no significant differences were found between the level of enrollment and modality of ICT integration (X^2 = 6.24; p > 0.05), or in relation to the first year fee (X^2 = 3.78; p > 0.05).

With regard to the quality of the educational institution, no significant differences were identified in the modality of integration when differentiating between the ranges of accreditation obtained (X^2 = 11.10; $p > 0.05$), or in the proportion of lecturers who have a doctorate (X^2 = 25.07; $p > 0.05$). Finally, in relation to the structural aspects, no significant differences were found between the modality of integration and the proportion of full-time lecturers (X^2 = 6.93; $p > 0.05$), or between the ratios of computers to students (X^2 = 11.51; $p > 0.05$).

Table 4. Modality of integration in study programs by level of training (n = 225)

	Full integration	Only profile	Only subject	No integration	($\alpha = 0.05$)
Elementary/secondary ITT					X^2 = 5.30;
Elementary	2.22	3.11	7.11	7.56	Pr = 0.151
Secondary	20.44	12.89	19.11	27.56	
Geographic location					X^2 = 17.56;
Northern zone	6.25	2.23	6.25	13.84	Pr = 0.007
Central zone	9.38	8.04	8.48	15.63	
Southern zone	6.70	5.80	11.61	5.80	
Type of institution					
University/professional institute					
University	22.67	15.56	25.78	34.22	X^2 = 1.39;
Professional institute	0.00	0.44	0.44	0.89	Pr = 0.708
Member of CRUCh					X^2 = 0.82;
Member	14.22	10.22	17.78	24.44	Pr = 0.844
Non-member	8.44	5.78	8.44	10.67	
Sustainability indicators					
First year enrollment					
High	11.11	6.67	9.78	10.22	X^2 = 6.24;
Medium	4.00	3.11	4.44	6.67	Pr = 0.397
Low	7.56	6.22	12.00	18.22	
Fee					
High	12.44	9.33	16.44	21.33	X^2 = 3.78;
Medium	4.00	4.00	3.11	5.78	Pr = 0.706
Low	6.22	2.67	6.67	8.00	
Quality of centers					
Accreditation					
Not accredited	2.22	1.78	3.56	6.67	X^2 = 11.10;
2 to 3 years	6.67	5.78	3.11	7.56	Pr = 0.085
4 or more years	13.78	8.44	19.56	20.89	
Lecturers with doctorate					
High	5.78	6.22	3.11	5.78	X^2 = 25.07;
Medium	8.44	5.33	16.89	24.00	Pr = 0.278
Low	8.44	4.44	6.22	5.33	
Structural aspects					
Full-time lecturers					
High	12.44	10.67	16.44	19.11	X^2 = 6.93;
Medium	10.22	4.89	8.44	13.33	Pr = 0.327
Low	0.00	0.44	1.33	2.67	
PC/student ratio					
High	4.00	3.56	1.78	2.22	X^2 = 11.51;
Medium	12.44	4.89	10.22	12.44	Pr = 0.074
Low	8.00	7.56	14.22	18.67	

Source: Prepared by the authors.

Discussion

In this paper we have presented a descriptive analysis that provides an overview of the level of incorporation of ICT into ITT in the various higher education institutions around the country, which constitutes a baseline contribution and a starting point considering the need to train 21st century skills.

With regard to the first question asked in this study, four modalities of integration of ICT have been identified, the most frequent being non-incorporation (35.1%), while integration in the subjects and not being mentioned in the graduate profile accounts for a significantly lower proportion (26.2%), followed by integration in the subjects and also mentioned in the graduate profile (22.7%), and finally, where ICT is mentioned in the graduate profile, but there is no incorporation of ICT subjects into the curriculum (16%). It should be noted that although 65% of the study programs do demonstrate some form of integration of this content, this proportion may possibly include different phenomena. On the one hand, the graduate profile for a degree course can mention ICT skills, even though there is no focus on them at some point in the course in a specific subject with this purpose, and these skills may be part of transversal training. On the other hand, it is possible to think of other cases where, for example, the graduate profiles mention these skills and others that are not trained transversally or through particular subjects. Future research with a representative sample of study programs, along with a qualitative study with key ITT actors (students, lecturers, and experts), would allow us to "open the black box" that constitutes each subject in a study program.

Besides the pending work that has to be pursued further, the findings allow us to talk about indicators of a significant lag in the integration of ICT into ITT, which is consistent with that described by Brun and Hinostroza (2014), who, using other indicators, concluded that this lag in the integration of ICT into ITT is at least 10 years. This contrasts with what is stated by Mineduc, which claims that one of the focuses of action to improve learning and promote the modernization of the Chilean educational system is "Enhancing and promoting the use of technology as a tool to facilitate and accelerate learning, while allowing us to prepare for future challenges"(Mineduc, 2019, paragraph 5). However, in contrast to all of the evidence of the radical importance of ITT in these innovations (Aydin et al., 2016; Ottenbreit-Leftwich et al., 2010), the *Plan nacional de lenguajes digitales año 2019* (National plan for digital languages in 2019) focuses on continuous training and includes actions to train the teaching staff of the educational establishments along three general lines:

- Provide training activities to teachers and/or professionals in the subject of Technology, who give classes to courses from first to sixth grade of elementary school.

- Provide training activities to teachers and/or professionals from subjects other than Technology, who give classes to courses from first grade of elementary school to 12th grade of secondary school.

- Provide training activities to the administrative team of the establishment, in order to lead the initiative (Mineduc, 2019).

It is also worth asking about the basic competencies with which graduates of degree courses that do not have ICT integration will face these training processes, and in turn, whether the policy considers the diversity of experiences with digital technologies in ITT.

It is similarly essential to bring things up to date by making changes to the training programs, incorporating ICT skills into the training programs, and making available the necessary equipment (the surprisingly low proportion of computers per student). However, at the same time it is also necessary to take on new challenges. Firstly, the marked presence of technologies in society and particularly among school students, who preferably use them for entertainment (videogames) and communication (social media), makes it essential to equip future teachers with the tools to understand and incorporate this reality into their work. Secondly, it is necessary to

consider the role that ICT can play in promoting skills for the 21st century (Pellegrino & Hilton, 2012), which go far beyond certain technical aspects directly related to ICT, including other cognitive, interpersonal, and intrapersonal competencies, whose relationship with digital technologies must be pursued further.

With regard to the second question in the study, the results show relevant and striking findings, contradicting what public opinion seems to indicate. For example, it is surprising that variables such as membership of CRUCH, quality indicators (accreditation and lecturers with doctorates), structural variables such as the PC/student ratio and the type of contracts of lecturers, the indicators of the viability of the educational project (enrollment and fee), and the educational orientation of the program (Elementary or Secondary), are not associated with any difference between the modalities of integration. The only variable that does show differences is the geographic location, which displays a lag, particularly in the north compared with the center and south. These findings pave the way for further discussion and questions. Therefore, in first place, this lack of relationship with the variables examined suggests that the integration of ICT into ITT does not seem to be linked specifically to structural efforts, nor does it have visible effects on the results of accreditation processes. Likewise, it is not related to frequently discussed aspects, such as the number of students and the cost of the programs. It thus remains pending to reflect on how to deal with the forthcoming changes in education, starting with a transformation of the ministerial policy to address digital inclusion and innovation, considering that this policy permeates the requisites and requirements of accreditation processes and the institutional management of Pedagogy programs, with institutional accreditation being understood as a driving force for improvement and institutional management being what sustains any educational project.

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