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ePortfolio to promote networked learning: an experience in the Latin American context

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Abstract

This research shows and analyses a pedagogical experience with ePortfolio into the bridge context between higher education and profession in Latin America, particularly Architectural Design Studio (ADS). The objective was to reveal the impacts of ePortfolio use as a tool of Information and Communication Technologies (ICT) on the training process to enhance Networked Learning Principles (NLP) into the particular architectural pedagogy. The research had a descriptive methodology with a qualitative approach through a perception survey applied to a sample of students from eight cohorts of the same training cycle (second year) in a ADS across years 2015–2018. The study kept its design and implementation fidelity stable during this time, allowing data from eight instances. The results allow observing relationships between the training process dimensions and the NLP, with indicators to improve this relationship, throughout to observe transformations linked to the ePortfolio conception, implementation and projection. The conclusions are related to the ePortfolio capacity to close strategic gaps in the training learning process to design, organise and provide feedback to improve the NLP, creating training strategies that promote students' autonomous learning, connections, identities, needs, aspirations and professional objectives.

Keywords: ePortfolio, Higher education, Educational innovation, Networked learning, Blended learning

Introduction

In the Higher Education context in Latin America, ICT presents a tendency to autonomy and lower levels of coordination and dependence with the agencies in charge of education in the different countries that comprise it (Brun, 2011). Despite the significant advances in Internet penetration in the region (Miniwatts Marketing Group, 2022), there is a need for greater clarity of the fundamental objectives, the social context of insertion of ICT, and its tools to articulate pedagogical plans, methodologies, and practices (de Benito & Salinas, 2005). The generation of a context is required to facilitate learning links and the recognition of different advantages of ICT when responding to students, teachers, and the educational community's personal, social, and training needs (Hernández, et al., 2011).

Specific studies in the Latin American educational context give an account of this. Cabero and Marín (2013) state that Latin American students (regardless of the country

of origin) present significant predispositions and attitudes to approach the methodological perspective of group work with the support of ICT and social networks, considering it as a way of working in the knowledge society. On the other hand, Said Hung, et al. (2015) in a study of the educational context in Colombia and Brazil, raise the need to strengthen reflection and criticism linked to the foundations of effective action of the different ICT resources and tools to increase the incidence of technology in teaching and learning processes. The above is derived from the trend towards an instrumental vision in using ICT rather than an approach oriented to learning hand in hand with technology. The ICT use implies that not simply by putting these technologies at the service of education professionals and students, they are being used appropriately (Aldahdouh, et al., 2020).

ePortfolio in Latin American higher education context

The ePortfolio is defined as a compilation of the work of students and teachers to document the experience and as an instrument for recording student evaluation (Barak & Maskit, 2017), helping students to reflect on their process and academic progress (Cebrián-de-la-Serna, et al., 2015). It is understood as an ICT tool mediating students' teaching and learning process within specific educational contexts (Mercado & Duarte, 2019). In the higher education Latin American context, the ePortfolio presents different modalities and scales (Rama & Pardo, 2010) according to user requirements: in institutional accreditation processes or study programs, in training in higher education (Soleto, et al., 2018) and training in integral aspects of communities, such as sustainable development (Fosado, et al., 2018). Some examples can be observed in research for different disciplines: in architecture (Osorio, 2020; Roco & Barberà, 2020b), where the ePortfolio is incorporated as an isolated experience in the training process; in medicine (Sartori, 2016), where the ePortfolio serves to observe the trajectory of a practicum and education (Peña, et al., 2015) where it is used as an input for the training of teachers in educational technology in countries such as Peru, Chile, Argentina and Colombia.

The experiences reviewed show the heterogeneity in the ePortfolio conception by integrating it into the teaching and learning processes. Besides, it presents differences in the definition of the strategies used for its implementation and projection. These are subject to the social and cultural characteristics of the different countries where they have been implemented (Pujolà (ed.), 2019). It is crucial to account for the diversity in the incorporation of ICT into the training processes carried out and the ability of the ePortfolio to support the participation, collaboration, and reflection of its users in formal and informal settings (Roder & Brown, 2009).

The ePortfolio as a strategy for NL

The NL is defined as learning in which ICTs promote connections between a learning community and its resources (Goodyear, 2005). More recent studies define it as a learning approach that equips people to work creatively, identify and construct problems, find the resources to face the issues identified and develop solutions within a mental flexibility scheme (Jones, 2015). NL is distinguished as a field of research and practice (Networked Learning Editorial Collective, 2021) that focuses its attention on interpersonal

human relations, technology (especially ICT) and collective commitment in valued activities.

In the search for ways to implement designs or programs based on NL, eight fundamental principles have been developed for their implementation (Hodgson & McConnell, 2019), through which they seek to cover the breadth of their conception. Dohn, et al., (2018) have established four concepts of NL, each of which emphasises a different set of connections in a learning community: (1) an emphasis on the connections between the people and how they develop, maintain and learn from the networks of others; (2) an emphasis on connections between situations or contexts (how people make connections between such situations, transforming or reconstructing their knowledge to use it in different situations); (3) an emphasis on ICT infrastructure and how they allow connections across time and space, including connections between situations, border crossings and mobility; and (4) an emphasis on connections between participants and learning situations.

Within the NL approach, the implementation of the ePortfolio is presented as a tool with high possibilities for communication and interaction of the members of an educational community, supporting the learning process and helping learners recognise and develop their itineraries of self-regulated learning (Alexiou & Paraskeva, 2019). From the articulation between the concepts of NL and the ePortfolio implementation, it is possible to visualise an educational intervention that is aimed at facilitating new options to explore and develop connected scholarly interests, with opportunities at the academic, professional, and civic levels (Esteban-Guitart, et al., 2020).

The ePortfolio for the hyperconnected educational context

In this pedagogical and technological environment, self-regulation of learning becomes a key factor for students to use technology to plan, organise and facilitate their learning. One of the technologies available to support this process is the ePortfolio (Romero, et al., 2019). This is understood as the ePortfolio where the student includes and collects material that shows their learning progress, helping them identify which aspects it dominates and which others it should improve (Barberà, et al., 2006). The ePortfolio should involve carrying out reflection, planning, synthesis, presentation, discussion, and feedback, which assist students in self-regulation of their learning (Alexiou & Paraskeva, 2010). Besides, prepare for the inevitable change caused by digital transformation, influencing every part of our social and professional life (Educause, 2018).

The ePortfolio experience to enhance NLP in the ADS

Teaching in the ADS is considered a particular pedagogy where a professional situation is reproduced in an academic context through a specific theme (Masdéu & Fuses, 2017), structured mainly to educate the student for their new professional practice. Shulman (2005) distinguishes three dimensions in this particular pedagogy: a superficial structure of operational teaching and learning acts, a profound system of assumptions about the best way to impact knowledge and an implicit system of a set of values, beliefs and attitudes constituted as a hidden curriculum. This particular practice of pedagogy in architecture is similar in other places, being of great relevance in contexts of bridging between formal education and the professional field (Amenduni & Ligorio, 2017).

Sense of NLP in the ADS

The ADS is a socially active environment of experimentation and collaboration between students whose individually or in small work teams students are invited to present the development of their projects in front of peers and expert audiences and are subjected to criticism by their tutors or other guests. Usually, the tutor's interaction between students is coordinated, defining the opportunities for students to share or discuss topics from their projects without the tutor's presence. The students have limited options to know and closely monitor what others are doing or relating their work to the project of their classmates, with ADS presenting the absence of a structure where students can share their material with others (Ioannou, 2018). Thus, the content provided by the students' own experiences or ongoing research is essentially not included from the ADS curriculum despite learning being built with individuals' existing knowledge (McClean & Hourigan, 2013).

In practice, teaching in ADS tends to isolate students from complex contemporary realities (of the profession and urban planning). According to Buchanan (2012), training in architecture is still oriented to produce lonely geniuses rather than collaborators. However, technological advances, especially the web, have allowed improvements in virtual collaboration and communication among the participants of an educational community. Thus, the web began to be considered a current resource of knowledge that offers a low cost in communication and abundant information, allowing active and autonomous agents (Anderson, 2016).

The ePortfolio implementation

Under these principles, the implementation of the ePortfolio was conceived as a complementary and parallel pedagogical strategy to the usual training process in ADS, with a particular interest in two conceptions of NL (Dohn et al., 2018): the connections between people and how they develop them, maintain and learn from the networks of others; and the ICT infrastructure and how they allow connections across time and space, including relationships between situations, a crossing of boundaries and mobility. To these conceptions is added the idea of Blending Learning proposed by Mcgee and Reis (2012), where the instructor and the learners work together in mixed delivery modes to achieve learning objectives that are pedagogically supported and link the environments of the course in a meaningful way for the student. The instrumentalisation of the ePortfolio was carried out through the blog-type Web 2.0 platforms (Blogger and WordPress). These allowed the incorporation of individual and institutional services used to create and publish ePortfolio presentations, allowing high levels of interactivity (feedback, comments, and edits collaborative) along with high levels of personal expression and creativity for the creator of the ePortfolio (Barrett, 2008). The URL for each ePortfolio was incorporated as an open record within the ADS, hosted in an institutional open-source Learning Management System (LMS) called Resource Environment for Online Knowledge (ARCO). The course tutor administered ADS registration and allowed free access and communication management from and to the different students' ePortfolios. The ePortfolios were created and developed for the students, having the freedom to have personal and institutional technological resources (laptops, computer

labs, internet networks, cell phones) to facilitate the development of their learning evidence, according to the proposed by (Hernández et al., 2011).

Characteristics of the ePortfolio innovation

The incorporation of the ePortfolio in the ADS training structure was conducted through 4 sequential stages in the semester, which was oriented towards achieving a transformative blended described by Bonk and Graham (2005). In this structure, the pedagogy is led towards a model where learners are not only receptors and knowledge is actively built through dynamic interactions: Induction stage defining the conditions for its use and the regulations for the implementation of the ePortfolio; monitoring stage with systematic monitoring and quantification of the learning evidence present in each ePortfolio; synthesis and evaluation stage, carrying out integrated analysis of the quantitative and qualitative data of the learning evidence gathered in the ePortfolios; and the validation stage, sharing and reflecting on the results obtained with the students, tutors and experts (guests) (Fig. 1).

The work with ePortfolio counted with five conditions which observed the advantages of web 2.0 about NL, understood as "being learning", where ICTs are used to promote connections between apprentices, between apprentices and tutors, and between a learning community and its learning resources (Goodyear, 2005): (a) complete at least one weekly update during the school period, (b) present an identity structure for the ePortfolio (characterisation of the author, objectives, goals for the work), (c) present personal reflections on constructed learning, (d) make at least ten comments (feedback) in different peer ePortfolios, and (f) develop a design and personal identity for the ePortfolio.

ePortfolio to promote the NLP

The educational innovation promoted the ePortfolio introduction can be understood as the articulation between the penetration conditions of ICT in the regional implementation context and the benefits of the joint implementation of blended learning and NL within the particular context of the teaching of architecture. As a result, it is possible to observe the impacts of ePortfolio use as an ICT tool on the training process to enhance Networked Learning Principles (NLP) into the particular architectural pedagogy, reflecting on the adaptations in its implementation, conception, and projection. The previous

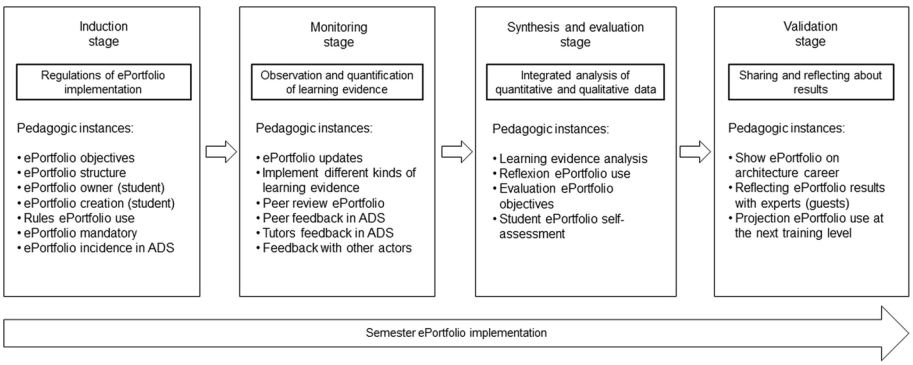

Fig. 1 Sequential stages for ePortfolio implementation in the ADS. Source: Authors' elaboration

could be extrapolated to other contexts and disciplines with similar characteristics highlighting the connections between higher education and the profession, which have not maintained a stable foray into the educational fabric mediated by technology. From the observation of its effects, the questions that guide this research arise:

RQ1_ What adaptations of educational innovation (mediated by ePortfolio) allow a more significant contribution to NLP development from the particular architecture pedagogy in ADS?

RQ2_ What NLP has the most potential for transitioning to new learning opportunities, promoting their articulating role between higher education and the profession in the ADS?

With this, it is possible to analyse an educational innovation where the pedagogical strategy, the particular formative context, the construction of disciplinary learning and the projection of knowledge intend to incorporate aspects of the specific cultural context. And from the specific ADS training context, which is shared for Latin American architecture schools.

Methodology

The methodological design of this research seeks to observe and analyse the impact of the implementation of the ePortfolio in the particular pedagogy of ADS within the context of a Latin American architecture school. It is qualitative and applied in nature (Creswell & Plano Clark, 2011) with a descriptive design. It is framed within the pragmatic paradigm, where the theoretical approach is oriented towards effective practice, and the knowledge generated can be judged based on its applicability (Schoonenboom & Johnson, 2017). The analysis developed over eight academic semesters between 2015 to 2018 in an ADS of the initial training cycle (second year) in the Architecture School of the University of Concepción, Chile.

The data was collected through observation and follow-up protocol to the students' ePortfolios, and a survey to know the perception of their use, established for the different semesters of the study period. With these data, integrated statistical analyses of the characteristics of the collected learning evidence (images, texts, links, videos, comments, reflections) and their operational evaluations were carried out. All the information was worked through tables and graphs compared.

The sample was of 65 students who took the ADS in one of the different semesters considered, and they developed an ePortfolio as part of their training process. The students answered a perception query (Additional file 1: Appendix 1) about the impact observed in the ADS training process for the inclusion and use of the ePortfolio, both individually and collectively. The query was validated by experts and was developed and shared online through the Google Form application and answered anonymously. The query included 43 questions organised into four sections, each of which responded to a previously defined dimension of the training process (Table 1). The query's work followed the institutional ethical norms for collecting, processing, and safeguarding the participant's sensitive information. A 5-level Likert scale was available to determine the degree of agreement or disagreement with each question posed. Each level of the Likert scale was associated with a numerical value to quantify the perception results: 2 for "strongly agree", 1 for "agree", 0 for "neither agree nor disagree", − 1 for "Disagree" and

Table 1 The query structure with questions distributed on different dimensions and levels. Source: Authors' elaboration

Dimension	Level	Questions
D1_ perception of ePortfolio adaptations in the TDA teaching and learning strategy	Individual (i)	D1(i) _ most customised reviews
		D1(i) _ finding guidance to solve a problem
		D1(i) _ communicate project ideas
		D1(i) _ development of reflections on the workshop itself
		D1(i) _ development of peer cooperation
		D1(i) _ continuity of workshop work
		D1(i) _ development of teamwork
	Collective (c)	D1(c) _ how to review workshop work
		D1(c) _ how to assess the work carried out
		D1(c) _ how to communicate project information
		D1(c) _ how to interact with peers and teachers
		D1(c) _ how to reflect student identity
D2_ perception of ePortfolio adaptations on the training context	Individual (i)	D2(i) _ reflection on the work done
		D2(i) _ collaboration with other workshop members
		D2(i) _ the ability to communicate ideas about their work
		D2(i) _ the incorporation of more information on the work carried out
	Collective (c)	D2(c) _ the construction of a collective reflection on workshop work
		D2(c) _ collaboration with other workshop members
		D2(c) _ the development of the group or teamwork
		D2(c) _ the development of peer reviews
D3_ perception of ePortfolio adaptations in the construction disciplinary learning	Individual (i)	D3(i) _ the development of a technical reference framework on architecture
		D3(i) _ the understanding of space and its spatial properties
		D3(i) _ understanding the architectural context of a project and its requirements
		D3(i) _ the handling of architectural language
		D3(i) _ the development of a project strategy to address projects
		D3(i) _ the development of a critical reflection on the projects carried out
		D3(i) _ the development of graphic communication tools for projects
		D3(i) _ the development of argumentative tools for projects

Table 1 (continued)

Dimension	Level	Questions
D4_ perception of ePortfolio adaptations in the projection of the training process	Facilitating (f)	D4(f) _ maintain the use of the blog format for its development
		D4(f) _ Incorporate another format (Websites, dropbox, drive, etc.)
		D4(f) _ incorporate social media platforms (Facebook, Instagram, Linkedin, etc.)
		D4(f) _ maintain student status as the owner
		D4(f) _ Incorporate a centralised management system (institutional type)
	Improve (m)	D4(m) _ maintain the use of e-portfolio as a mandatory activity
		D4(m) _ to apply to the e-portfolio greater percentage of the semester evaluation
		D4(m) _ planning constant e-portfolio reviews throughout the semester
		D4(m) _ Making e-portfolio the mainstay of the teaching and learning process
		D4(m) _ to establish the e-portfolio as the basis for the final semester evaluation
	Projection (p)	D4(p) _ use of e-portfolio in other workshops in the career
		D4(p) _ use of e-portfolio as a lifelong learning strategy
		D4(P) _ use of e-portfolio as a basis for validation of student training
		D4(P) _ use of e-portfolio as a basis for students' presentation to the final project
		D4(p) _ use of e-portfolio as a final project

− 2 for "strongly disagree". The perceived ePortfolio actions were established at the end of the training learning process, in the validations stage for ePortfolio implementation. The data were analysed using QDA Miner Lite Software version 2.0.8.

For the four dimensions of the training process in ADS, an interpretation of the dimensions proposed by Shulman (2005) was made, on which the implementation of the ePortfolio allowed observing adaptations or adjustments associated with the following actions:

a. D1_ The teaching and learning strategy (at the individual and collective level) incorporates proposed actions to facilitate and improve learning, such as developing reflections, personalised reviews, teamwork, the interaction between workshop members, expression of a student's identity.
b. D2_ The training context (at the individual and collective level) incorporates actions in aspects of the formative tradition of architecture such as collaboration between members of the workshop, the construction of a collective reflection, group work and correction among peers.

c. D3_ The construction of disciplinary learning includes actions in the elements of architectural knowledge (Roco & Barberà, 2020a), such as management of architectural language, development of project strategy, development of communication tools, development of argumentative tools.
d. D4_ The projection of the training process incorporates actions to facilitate, improve and enhance NL through a longitudinal view of the development of teaching and learning during training time.

Query structure looked for to relate the relevant areas of a techno-pedagogical design (Coll, et al., 2008), where the ePortfolio and the dimensions of the training process are framed. The degree of perceived contribution is related to the sum of the values assigned to the Likert scale for the different proposed dimensions. This relationship can be observed in Table 2.

The ePortfolio innovation in ADS was related to the eight NLP—Networked Design Principles, according to Hodgson and McConnell (2019). A correspondence matrix was established, defining a global observation guide structure as the comparative basis for contrasting the students' perceptions (Additional file 2: Appendix 2). In Fig. 2 can be appreciated the graphic guiding structure. The reference level represented the sum of the different dimensions' scores for each NLP. They are associated with the hypothetical impacts of the innovative actions promoted by ePortfolio in the training process.

The values on the global observation guide mean that all innovation actions have differential impact degrees to enhance the NLP in the ADS. Most NLP present over 50% (score 21.5) of the potential impact, and only two NLP (3 and 8) have less than 50%. The differential impact degrees are possible because the innovation actions work in different techno-pedagogical design areas implemented by ePortfolio, and none reach 100% impact (score 43). Then, the global observation guide shows a reference and a hypothetical structure over which it is possible to observe more specifically the students' perceptions.

Results

RQ1_ What adaptations of educational innovation (mediated by ePortfolio) allow a more significant contribution to NLP development from the particular architecture pedagogy in ADS?

The results showed that 86% (37 out of 43) of innovative action impacted NLP development. Only 14% (6 of 43) did not observe some effect. Table 3 shows the contribution percentage of each perceived item in different training process dimensions and levels.

The training process dimensions had different incidences on NLP development, associated with the percentage in the perception for each level (Table 4). The D1 (teaching and learning strategy) and D4 (projection of the training process) had the most significant contribution. However, none dimension presented a level contribution higher than 28% or less than 22%, which could mean that all dimensions are relevant for NLP development in ADS. On the other hand, regarding the different perception levels, the individual and collective levels represented the highest incidences, with 49.5% and 23.6%, respectively. Both levels are present in more than one dimension. The facilitating,

Table 2 Summary of innovative actions and their relationship with the training process dimensions in ADS (adapted from Shulman)

Innovative actions			Dimensions			
			Teaching and learning strategy	Training context	Construction disciplinary learning	Projection of the training process
Operating conditions	1	Mandatory use of ePortfolio	x	x	x	x
	2	Freedom to select blog platform to develop ePortfolio	x	x		x
	3	Freedom to express identity in the ePortfolio	x	x	x	x
	4	Freedom to incorporate diverse learning evidence	x	x	x	x
	5	Freedom for ePortfolio content development	x	x		
	6	The student who owns the ePortfolio	x	x	x	x
	7	ePortfolio visibility for all ADS members	x	x	x	x
	8	Reviews at the student's request	x	x		
	9	Freedom to use the ePortfolio of previous courses	x	x		
Technical conditions	10	Use of blog platform for ePortfolio development	x	x	x	x
	11	Use of student's technological resources	x	x		x
	12	Requirement for Internet access	x	x		
	13	Visibility of the dates when entries are made in the ePortfolio	x	x		x

Table 2 (continued)

Innovative actions			Dimensions			
			Teaching and learning strategy	**Training context**	**Construction disciplinary learning**	**Projection of the training process**
Procedures	14	ePortfolio complements the traditional teaching and learning process in ADS	x	x	x	x
	15	A weekly update of the ePortfolio	x	x	x	x
	16	Comment on the ePortfolio of other workshop members	x	x	x	x
	17	Incorporating reflections into the learning process	x	x		
	18	Compliance with the basic structure for the development of the ePortfolio	x	x		x
	19	Evaluated reviews of the ePortfolio	x	x	x	
	20	ePortfolio part of the semester evaluation (10%)	x	x	x	x

Source: Authors' elaboration

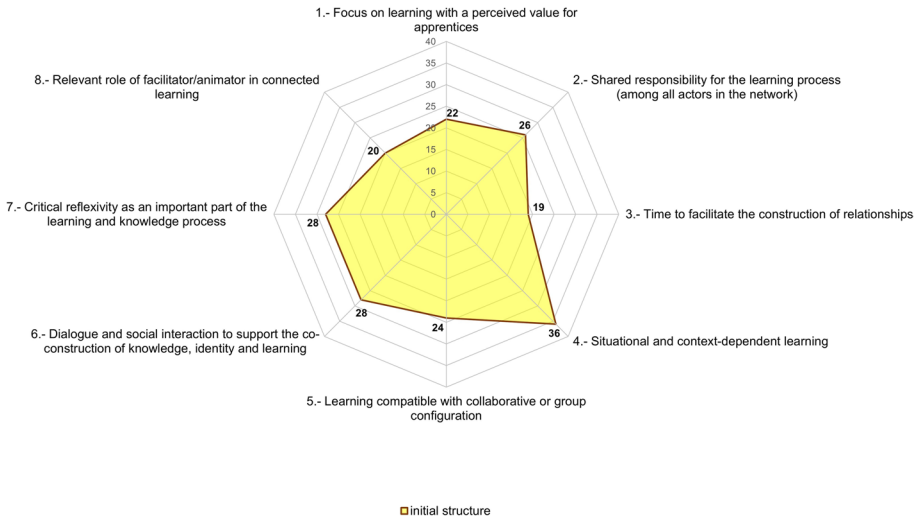

Fig. 2 Guiding structure for global observation of NLP in ADS. The NLP score corresponds to the value obtained from the observation guide matrix (Additional file 2: Appendix 2), with a maximum score of 43. Source: Authors' elaboration

Table 3 Perception level about the ePortfolio actions contributing to NLP development

	Training learning Dimension	perception levels percentage				
Query item	**D1_ Perception of ePortfolio adaptations in the TDA teaching and learning strategy**	individual (i)	collective (c)	facilitating (f)	improve (m)	projection (p)
1	D1 _ most customized reviews	2.3				
2	D1 _ finding guidance to solve a problem	1.8				
3	D1 _ communicate project ideas	1.4				
4	D1_ development of reflections on the workshop itself	4.5				
5	D1 _ development of peer cooperation	2.3				
6	D1 _ continuity of workshop work	3.6				
7	D1 _ development of teamwork	0.0				
8	D1 _ how to review workshop work		2.7			
9	D1 _ how to assess the work carried out		1.8			
10	D1 _ how to communicate project information		1.4			
11	D1 _ how to interact with peers and teachers		2.7			
12	D1 _ how to reflect student identity		2.7			
	D2_ Perception of ePortfolio adaptations on the training context					
13	D2 _ reflection on the work done	1.8				
14	D2 _ collaboration with other workshop members	2.3				
15	D2 _ the ability to communicate ideas about their work	3.6				
16	D2 _ the incorporation of more information on the work carried out	2.7				
17	D2 _ the construction of a collective reflection on workshop work		2.7			
18	D2 _ collaboration with other workshop members		2.3			
19	D2 _ the development of group or team work		0.0			
20	D2 _ the development of peer reviews		7.3			
	D3_ Perception of ePortfolio adaptations in the construction disciplinary learning					
21	D3 _ the debelopment of a technical reference framework on architecture	2.7				
22	D3 _ the understanding of space and its spatial properties	1.4				
23	D3 _ understanding the architectural context of a project and its requirements	3.6				
24	D3 _ the handling of architectural language	1.4				
25	D3 _ the development of a project strategy to address projects	1.8				
26	D3 _ the development of a critical reflection on the projects carried out	7.3				
27	D3 _ the development of graphic communication tools for projects	2.7				
28	D3 _ the development of argumentative tools for projects	2.3				
	D4_ Perception of ePortfolio adaptations in the projection of the training process					
29	D4 _ maintain the use of the blog format for its development			1.4		
30	D4 _ Incorporate other format (Websites, dropbox, drive, etc.)			2.7		
31	D4 _ incorporate social media platforms (Facebook, Instagram, Linkedin, etc.)			3.6		
32	D4 _ maintain student status as owner			2.7		
33	D4 _ Incorporate a centralized management system (institutional type)			0.0		
34	D4 _ maintain the use of ePortfolio as a mandatory activity				0.9	
35	D4 _ to apply to the ePortfolio greater percentage of the semester evaluation				0.9	
36	D4 _ planning constant ePortfolio reviews throughout the semester				3.6	
37	D4 _ Making ePortfolio the mainstay of the teaching and learning process				0.0	
38	D4 _ to establish the ePortfolio as the basis for the final semester evaluation				0.0	
39	D4 _ use of ePortfolio in other workshops in the career					2.3
40	D4 _ use of ePortfolio as a lifelong learning strategy					2.7
41	D4 _ use of ePortfolio as a basis for validation of student training					2.7
42	D4 _ use of ePortfolio as a basis for students' presentation to the final project					3.2
43	D4 _ use of ePortfolio as final project					0.0

The scores represent the average percentage per level in each training process dimension. Source: Authors' elaboration

Table 4 Training process dimension incidence in the NLP development

Dimension	**Perception levels percentage**					
	Individual (i)	**Collective (c)**	**Facilitating (f)**	**Improve (m)**	**Projection (p)**	**Total**
D1	15.9	11.4				27.3
D2	10.5	12.3				22.7
D3	23.2					23.2
D4			10.5	5.5	10.9	26.8

The scores represent the sum of percentages per level. Source: Authors' elaboration

improving, and projection levels present fewer incidences, and all are present in only one dimension.

In an integrated view of results, it is possible to observe that the dimensions with the most significant contributions (D1 and D4) are associated with different perception levels: D1 works with individual and collective levels, and D4 with facilitates, improving and projection levels. Dimension D2 and D3 also present different perception levels but

with a fewer contributions. Nevertheless, four dimensions propose a collaborative structure for the NLP development, emphasising a different set of relevant connections in the particular learning community.

The ítem with the taller percentage per level on each dimension allows recognising the major adaptation, mediated by ePortfolio, with a more significant contribution to NLP development (Table 5).

The adaptations reflected in Table 5 show the relevance of personal work and its immediate projection throughout the study period for different dimensions and levels. Aspects such as reflections about work carried out, student identity and reviews of the work in the semester are observed as the most important on the students' perceptions. On the other hand, items without a percentual score show the non-consideration of the development of teamwork and the innovation actions projection in a most extensive training period.

RQ2_ What NLP has the most potential for transitioning to new learning opportunities, promoting their articulating role between higher education and the profession in the ADS?

The initial and perceived structure results showed a positive increase on 7 of the 8 NLP, associated with the better perception of the innovating activities promoted by the ePortfolio. The gains were from 1 to 5 points obtained with the Likert scale total score. Only NLP number 2 had no difference, and there were no negative gains (Fig. 3).

In general, it is possible to understand that the set to innovative actions implemented in the ADS training process cloud has the potential to promote the articulation between higher education and the profession. Nevertheless, an analysis of the perception for each learning process dimension is necessary to confirm this first finding.

Regarding D1 (teaching and learning strategy), this showed 5 NLP with a positive increase and 3 NLP without a difference. The taller score was between 1 and 3 points on the Likert scale compared with the initial structure. The NLP that showed a majority positive perception was number 7: critical reflexivity as an important part of the learning and knowledge process (Fig. 4).

At the individual level, positive increases were observed on 4 NLPs (1, 3, 4, and 7), and no differences presented 4 NLPs (2, 5, 6 and 8). The higher point was 2 in NLP number 7. Positive increases showed on 3 NLPs (1, 6 and 7) at the collective level and

Table 5 Principal adaptations by ePortfolio with significant contribution to NLP development

Level	Item	Actions per dimension	Percentage
Individual	4	D1_ development of reflections on the workshop itself	4.5
	15	D2 _ the ability to communicate ideas about their work	3.6
	26	D3 _ the development of a critical reflection on the projects carried out	7.3
Collective	8	D1 _ how to review workshop work	2.7
	11	D1 _ how to interact with peers and teachers	2.7
	12	D1 _ how to reflect student identity	2.7
	20	D2 _ the development of peer reviews	7.3
Facilitating	31	D4 _ incorporate social media platforms (Facebook, Instagram, Linkedin, etc.)	3.6
Improve	36	D4 _ planning constant ePortfolio reviews throughout the semester	3.6
Projection	42	D4 _ use of ePortfolio as a basis for students' presentation to the final project	3.2

The scores correspond to the taller percentages per level. Source: Authors' elaboration

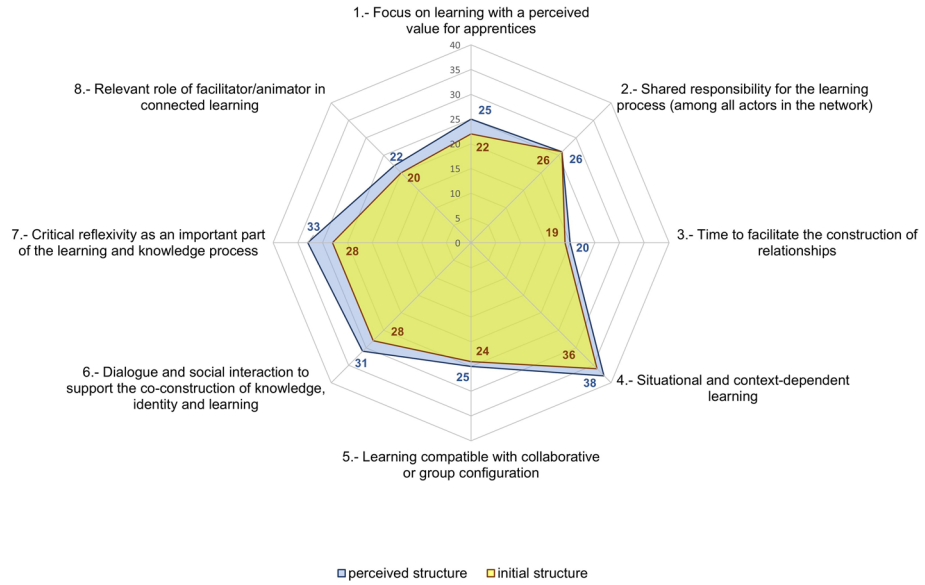

Fig. 3 NLP differences between perception structure and initial structure for NLP. The scale represents the maximum value observed between initial and perceived structures. Source: Authors' elaboration

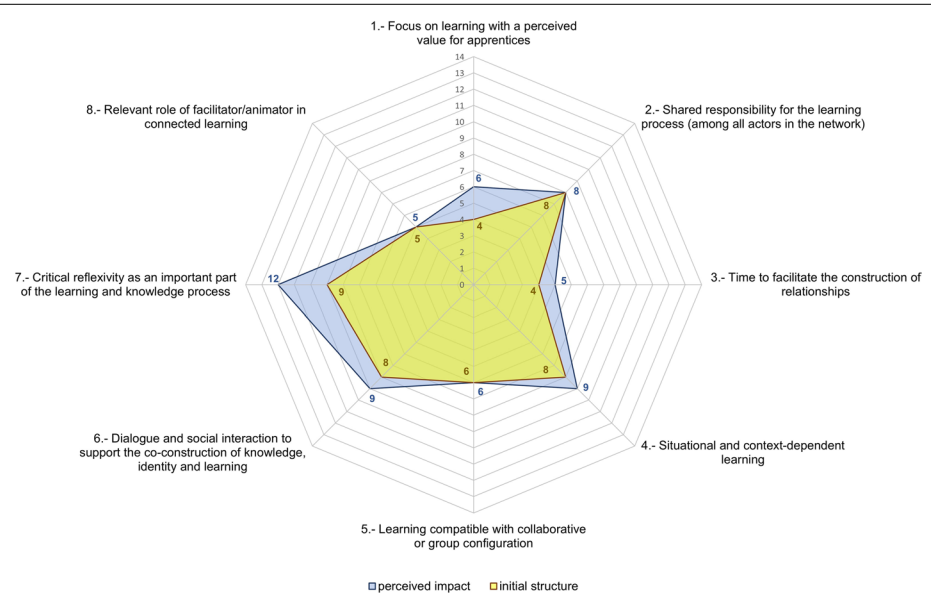

Fig. 4 NLP differences between perception results and initial structure on D1. The scale represents the maximum value observed between initial and perceived structures. Source: Authors' elaboration

without perceived differences on 5 NLPs (2, 3, 4, 5 and 8). In the integrated view of this dimension, the NLPs with more significant perceived potential were the NLPs 1 and 7. This could mean that the learning perceived value and critical reflexivity can play an articulation role in promoting higher education and professional integration, emphasising the connection between the people and how they develop.

In D2 (training context) is observed 6 NLPs with positive increases and two without differences. The taller score was between 1 and 3 points on the Likert scale compared with the initial structure. The NLP with the higher points was number 7, at the same that D1 (Fig. 5).

At the individual level, positive increases presented 5 NLPs (2, 4, 6, 7 and 8) and no differences in 3 NLPs (1, 3 and 5). The higher point was 2 in the NLPs number 4 and 7. Along with that, increases was observed in 3 NLPs (1, 7 and 8) at the collective level, and non-differences presented 5 NLPs (2, 3, 4, 5 and 6). In the integrated view of this dimension, the NLPs with more significant potential were 1, 7 and 8. In this case, learning perceived value and critical reflexivity maintain an equal relevance at the D1 and add the animator/facilitator role in the connected learning. This can mean a complementary emphasis on the connection between participants and learning situations in the NLP development.

A positive increase in D3 (construction disciplinary learning) was observed in the 8 NLPs. The taller score was 1 point on the Likert scale regarding the initial structure (Fig. 6). While every all NLPs had a positive increase, this is associated only with the individual level.

The D3 is related to the construction of disciplinary learning. Then we can understand that the training learning process can impact all of the NLP from an individual level with homogeneous but incipient impacts. Besides, this presents the same role on the D1 and D2 but adds new aspects, emphasising the connection between situations and context and how the infrastructure (especially ICT) allows connection across time and space.

Finally, in the case of D4 (projection of the training process) showed no positive increase on NLPs. Two NLPs (5 and 6) do not differ, and 6 NLPs (1, 2, 3, 4, 7 and 8) experimented with a negative increase. The taller negative score was 2 points on

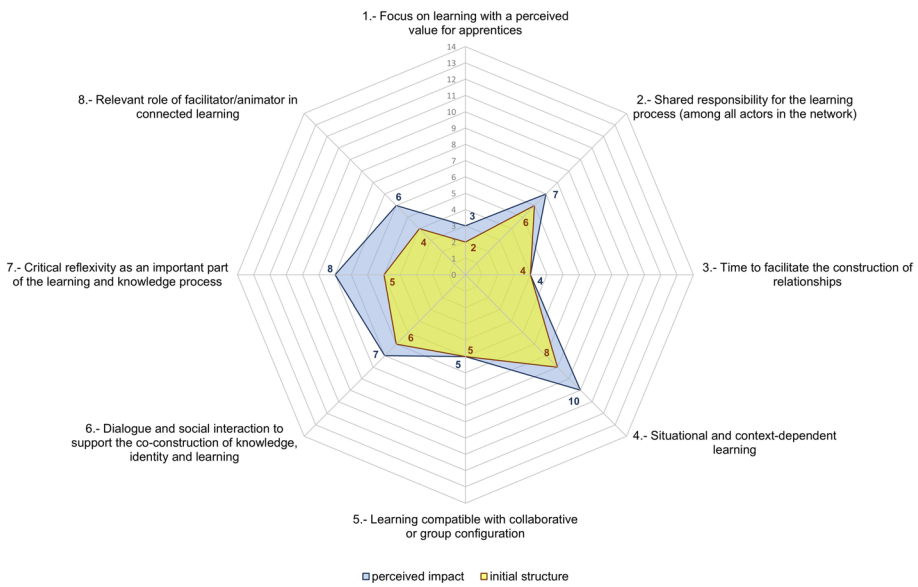

Fig. 5 NLP differences between perception results and initial structure on D2. The scale represents the maximum value observed between initial and perceived structures. Source: Authors' elaboration

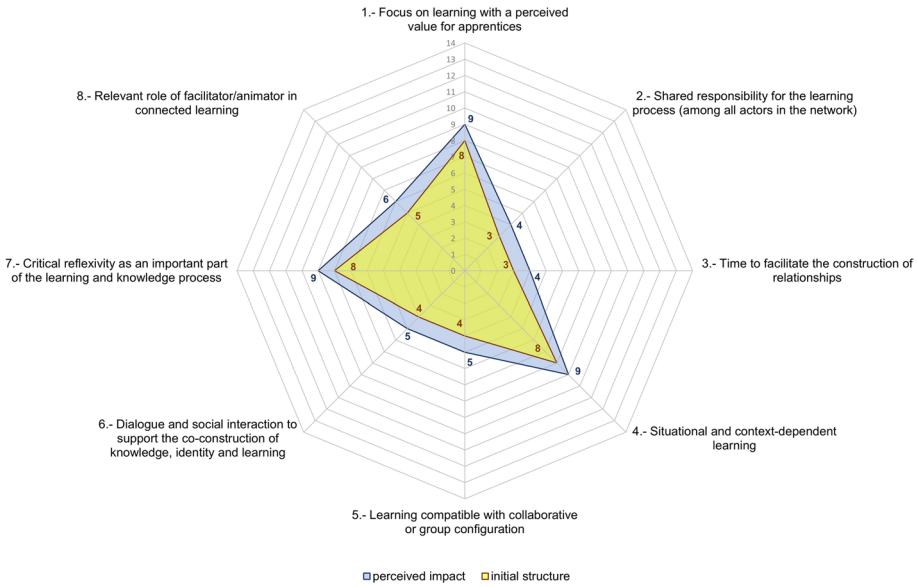

Fig. 6 NLP differences between perception results and initial structure on D3. The scale represents the maximum value observed between initial and perceived structures. Source: Authors' elaboration

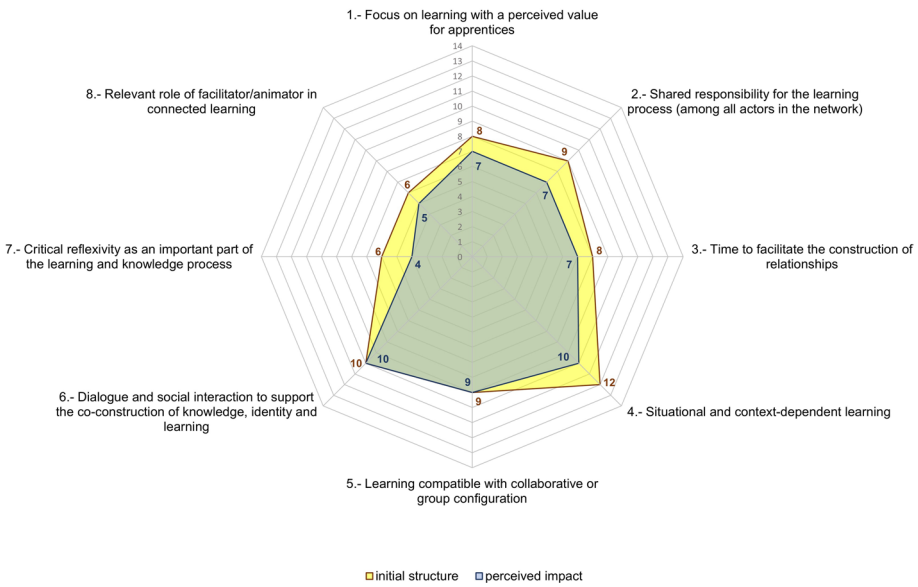

Fig. 7 NLP differences between perception results and initial structure on D4. The scale represents the maximum value observed between initial and perceived structures. Source: Authors' elaboration

the Likert scale compared with the initial structure. The higher negative points were NLPs 2, 4 and 7 (Fig. 7).

The three levels on this dimension (facilitate, improve and projection) showed contrasting aspects for each group. The facilitating level presents a positive increase on 5 NLPs (1, 3, 5, 6 and 7), no difference in one (NLP 4), and 2 NLPs (2 and 8) with a score of zero. The higher score was 3 points on the NLP number 6. The improve level shows

a positive increase in one NLP (8), no difference in other (2), 3 NLPs (3, 6 and 7) with a score of zero, and 3 NLPs (1, 4 and 5) with a negative increase. The higher score was 1 point, both positive and negative perception. In the case of the projection level, it only presents negative increases for all NLPS (1 to 8). The higher score was 1 point in all cases. In the integrated view, the NLPs with more potential were numbers 5 and 6, unlike NLPs 2 and 4 with fewer potential. This could mean that while the learning compatibility with group configuration and critical reflections are essential in the training process, the shared responsibility and the situational context are not values. The absence of perception about the improvements and projections for the NLP development was evidenced. Then, the main emphasis for this dimension could be only on the connections between the participants and the learning situation.

Finally, on the observations about these results, the NLPs with higher potential to promote the relationship between higher education and the profession in the particular ADS training process can be appreciated in Table 6.

All the NLP can promote connections between higher education and the profession. With the ePortfolio implementation, the NLPs 7, 6 and 1 present the taller impact. Critical reflection, dialogue with social interaction, and focus on the perceived learning are essential aspects to support these actions and constitute relevant characteristics of the particular ADS pedagogy.

Discussion

With the finds, it is possible to infer that the four dimensions of the teaching and learning process for the particular architectural pedagogy articulate the relationship with the NLP. The innovation actions based on ePortfolio implementation promotes the NLP, allowing the learning process to communicate the specific sociocultural context to which it belongs. Promoting the reflections about the work carried out, the student identity, and the systematic review impulse significant steps. Also, the lack of appreciation about teamwork development and the training process projections alert the NLP development's complexity. These can help understand the theoretical and practical internal tensions that underlie the development of the construction process of NLP, linking to the significance of the collective social project proposed by Networked Learning Editorial Collective (2021).

The ePortfolio innovation actions open opportunities to adjust the participants' role in the training process. The significative findings of the impact of individual and collective levels should impulse some of these adjustments. The critical reflection and the ability to communicate ideas in a personal sense, along with the peer interactions and reflect the student identity in the collective vision, promote the new pedagogical practices and their process projections. The level contributions could be associated with the proximity and direct link with the pedagogical strategies implemented in the teaching and learning process. Appear the necessity of co-construction instances allows the sharing of learning objectives, pedagogical practices, and participation in the learning co-design activities, according to proposed by Esteban-Guitart et al. (2020).

Concerning the NLP's potential to promote the articulation between higher education and the profession, the findings showed that all NLP could support this condition with ePortfolio sustain. The essential aspects were the critical reflections, social interactions,

Table 6 NLP with higher potential to promote the relationship between higher educations and the profession

Networked Learning Principles _ NLP								
	1. Focus on learning with a perceived value for apprentices	**2. Shared responsibility for the learning process (among all actors in the network)**	**3. Time to facilitate the construction of relationships**	**4. Situational and context-dependent learning**	**5. Learning compatible with collaborative or group configuration**	**6. Dialogue and social interaction to support the co-construction of knowledge, identity and learning**	**7. Critical reflexivity as an important part of the learning and knowledge process**	**8. Relevant role of facilitator/animator in connected learning**
D1	2	0	1	1	0	1	3	0
D2	1	1	0	2	0	1	3	2
D3	1	1	1	1	1	1	1	1
D4	− 1	− 1	− 1	− 2	0	0	− 2	− 1
Total score	3	1	1	2	1	3	5	2

The scores correspond to the Likert scale on the perception survey. Source: Authors' elaboration

learning focus, situational learning, and facilitator/animator roles, which could promote identity, social skills and confidence development. The articulate actions of these aspects contribute to growth elements to support knowledge co-construction and their professional contexts projections, according to Penuel et al. (2016). Knowing and recognising the participants' technological skills, their necessities, and the knowledge in the process (students and teachers) is crucial for NLP build, according to Bond et al. (2018). This is especially relevant when the relevant role of the facilitator/animator in connecting learning was less perceived. In this sense, ePortfolio plays an essential part in promoting new professional skills innovating in student learning as Sobrados (2016) proposed.

The positive impacts of ePortfolio innovation on the NLPs matches the conviction that networked cooperation is the usual way to work for the knowledge society in the regional implementation context, which is crucial to promote a more social vision of the learning process, according to Cabero and Marín (2013). Besides, all the innovation actions that support the NLP's potential to articulate higher education with the profession cover the four emphasises for the connections in a learning community, according to Dohn et al. (2018), doing special underline on the relationship between people and the connection between participants and learning situation.

It is interesting that the NLP projections throughout the extended learning training process the innovation actions could build a future vision based on the evidence of learning gathered and the potential for collaboration and reflection observed, according to De la Fuente et al. (2015). This is despite the findings showing an adverse increase for the NLP projection.

The ePortfolio, as an ICT tool, encourage participation and collaboration critically and actively, supporting the management, communication and social responsibility, all converging elements in NLP development for connecting higher education and the profession, following what was proposed by Fosado et al. (2018). Professional skills development is acquired and projected from the higher education training process. Encouraging the reflection about the need to introduce strategies as an ePortfolio innovation to develop the potential NLP is essential for the training learning throughout the student's training time. In this sense, the finding could be represented more than in a single unit or course, according to Roberts (2018).

Conclusions

This research about the ePortfolio to promote networked learning has shown how an innovative ICT tool can enhance the NLP development in the higher education local context, with a particular focus on the training learning process in ADS. The results denote how NLP can be impacted and its potential contribution to other related disciplines, which have similar necessities to observe new strategies to improve their NLP structures.

The ePortfolio innovation allows nurturing the Latin American higher education context and their relations with the professional environment. The training learning process mediated by ePortfolio, could help close strategic gaps to manage, plan and provide a set of pedagogical approaches to improve the match with the NLP implementation, including the personal learning, connections, identities and professional objectives. Diverse offers on the ePortfolio use for developing networked learning are ongoing processes in

the region. Nevertheless, the basis for increasing future coverage will be to maintain the diversity observed in multiple disciplinary areas.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s41239-022-00336-8.

Additional file 1. Opinion survey on ePortfolio use in the Architectural Design Workshop (ADS).

Additional file 2. Global matrix as a comparative basis of the students perceptions results.

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Authors contributions
MR is the principal researcher in this study. He drives the research and development of the information analysis about the data collected. He joins a little teamwork applied and collective the results from the proposal methodology structure, including quantitative and qualitative data. He is responsible for preparing and writing this paper. EB is the co-research in this study. She drives the main theoretical aspects of this research. She is responsible for checking and reviewing the coherence in the paper formulation process and supporting the articulation between practical and academic information. She is a co-writer of this paper. All authors read and approved the final manuscript.

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