Perception of Teachers on Collaborative Tools Knowledge Level Mediated by ICT and Their Experience with Students

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Rosalba Acosta Corporan (✉)
University of Salamanca, Salamanca, Spain
u139132@usal.es

Jorge Joo-Nagata
University of Educational Sciences, Santiago, Chile

Antonio Víctor Martín García, Azucena Hernández Martín
University of Salamanca, Salamanca, Spain

Abstract—In 21st century, competencies mediated with ICT are key for development at the educational area. This is the reason why this research aims to assess perception on level of competences of secondary school teachers on technological tools to promote collaborative work methodologies with their students and determine if said level has influence on the implementation of these experiences. Design implies a mixed model based on the application of a questionnaire divided in three parts: demographic aspects, level of knowledge on collaborative tools and experiences on collaborative work with students. Sample (n=542) corresponds to secondary education teachers from Dominican Republic. In analysis, nonparametric tests and categorizations were used. Results suggest that teachers require of a better formation on collaborative methodologies and tools mediated by ICT and, additionally, results indicate that there is a digital gap between male and female teachers, as the first group had more advantages.

Keywords—Collaborative learning, teaching competences, teaching role, technological programs, student satisfaction.

1 Introduction

It is undeniable that imminent changes in society involve a constant update and use of technological resources in order to carry out different tasks. These implications have reached the educational system [1], and generate, consequently, a duality in teaching work, new professional challenges, a menace for the profession and new educational reforms, among other aspects.

In accordance with international organizations as the Organization for Economic Cooperation and Development OECD [2] or the United Nations Educational, Scientific and Cultural Organization UNESCO [3], the educational agent of biggest importance

is the teacher, who is made responsible for the quality of the learning process in students and the possible school failure in different levels. There are many theories and much speculation about the teaching method of each teacher, but, from the point of view of government authorities, these ideas do not result in policies aiming to strengthen the initial and continuous formation of teachers. Thus, some countries are found at the top of an educational pyramid, in accordance with international reports as PISA reports 2012, 2015, 2018 [4], not only in the teaching formation quality, but also in the student performance, while others are not, and even if these countries try to imitate the educational system of said countries (Finland, Singapore, Japan, etc.), their success has been scarce or even non-existing [5], as they do not possess enough resources, necessary support, or merely because contextual conditions are diverse [6]. This is the case, in different grades, of Spain, Israel, Uruguay or the Dominican Republic, among others, where educational policies have been incorporated under an approach of a 2.0 school with high digital technological implementation.

Such models have recorded certain advances, such as reduction of digital gap, or the dotation of ICT equipment in educational centers, but teaching formation to complement technological dotation has been scarce. Additionally, it is possible to add the reticence of some teachers, who reject ICT use for teaching processes. Consequently, results have not been the expected [5], [7]- [9].

These weaknesses are produced, in several cases, because an important part of the teaching staff is not educated in this broad range of competences from 21st century, where the knowledge on technological tools promoting collaborative learning is highlighted. This situation is specially perceived in Latin American countries, where some educational policies displayed are cut off from the school reality, and where impact plans are left behind and incentives to teachers to let them improve their teaching processes are few [10].

It can also be added a lack of criteria for the staff selection process that will be working in classrooms and deficiencies in an initial and permanent formation [11], [12]. That is the reason why it is insisted on the necessity of forming teachers in key competences of 21st century (digital competences, initiative capacity, tendency to collaborative work, etc.) with the objective of improving teachers conception on use of ICT, reducing the current gap between teachers and students, improving educational practices, strengthening professional development, among others [7], [13].

It is considered that development of these competences should be facilitated by government entities, which can make possible that centers take initiative and teachers stand up for their development [14]. Within those entities, formation strategies on avant-garde methods that can help all types of students, and formation on tools allowing teachers to auto-regulate their learning and collaborate in their colleagues' formation are suggested [15]. From that perspective, Computer supported Collaborative Learning (CSCL), considered as a methodology in which two or more students interact to perform certain activities and mutually commit in order to achieve a purpose of common learning, bursts in. This is carried out with support of Information and Communications Technologies (ICT) and teacher's orientation [16].

1.1 Collaborative tools recommended for teaching and teaching formation in secondary school and high school

Secondary Education and High School are the most complex levels to give teaching lessons. It is in this stage when students are formed in necessary competences for life: collaboration, cooperation, solidarity, know how, etc. [17]. Said competences have the mission of preparing students for their university formation stage. This way, this double purpose encourages the teacher staff to be qualified and they are requested to use resources facilitating interactivity, collective learning and to contemplate the teaching rhythm of everyone [18].

Against this background, it is undeniable that the educational model shall commit to efficiently use new technologies in order to promote strategies such as interaction of varied nature, teamwork, individual and group responsibility, permanent formation, among others. However, it is important to clarify that the problem is not solved by giving computers to students and teachers, or equipping centers with technological facilities. A series of research have already stated this [7], [10], [19], [20], since these technological supports must be accompanied with an educational plan to work, which shall present an adequate formation [21].

In accordance with Horizon Report among tools that can contribute to promote the aforementioned strategies, always in a proper interaction with other elements of the plan, e-learning platforms, blogs, wikis, WebQuest, social network, educational robotics, office automation, files shared in the Cloud, audiovisual presentation, videoconferences, video repositories, concept maps and shared photo albums [22]. There are many other computational tools destined to collaboration, but here are mentioned some of the most used for creation, distribution and management of information in network, which were the object of this research and have been included in similar investigations [22]. They are justified since they are considered as collaborative tools, and because of their chances in the educational field.

E-learning virtual platforms (Moodle, Chamilo, Dokeos, among others) contribute to create an ideal scenery for a collaborative work because they allow contents management, the use of synchronous and asynchronous communication tools, follow up of the student learning rhythm and the measurement or assessment of student knowledge in certain contexts [23].

Blogs are personal spaces where news, links, etc., are shared. Nevertheless, they can be more interesting when the author adds a collaborative space, because the reader can make comments in the blog's entry. Therefore, this resource is considered one of the most successful methods for collaborative learning in virtual environment since their first apparition [24].

Wikis are an effective tool for the collaborative writing of documents; therefore, they have been adapted for university and non-university areas. The most evident example is Wikipedia, which have millions of articles. Due to its simplicity in education, there are numerous examples where wikis are used as communication and collaboration in class, whether as support to electronic portfolios or group projects [25], [26].

Regarding WebQuest, it is not possible to consider them as a tool, but rather as an activity of inquiry or research oriented to students so that they can obtain most of the

information they are going to use from existing resources on Internet. WebQuest is also considered a teaching model based on development of projects or problems resolution with support of ICT. For this reason, some authors state that it is a collaborative work methodology whose theoretical base is substantiated on constructivism and cooperativism [27].

Similarly, social networks (Facebook, Edmodo, Twitter, etc.) answer to those collaborative patterns as they are based on social interaction and communication among their members in order to create knowledge. In other words, they nurture from experience among their members. These can be grouped around different interests or utilities and offer an alternative to create, share and debate contents outside the classroom [28].

Robotics is a technology that emerges as a response to industry needs to perform repetitive and constant works in an automatized way. Despite that, robotics has been developing in a variety of fields, and education is one of them. Its use is still not generalized; however, it has been successful when used in abstract and complex concepts in STEM courses. This tool allows the development of basic competences such as teamwork, cooperation, problems resolution, self-learning, among others. All of this is achieved because said activities are carried out through guided projects [29].

Other tools that are also considered very useful in learning activities are cooperation tools on the Cloud, or Cloud Computing, which allow creation, edition and sharing of joint information. Some of these tools are Google Docs, Onedrive, Dropbox, among others [22], [25].

After having defined collaborative functionalities of the presented tools, it is necessary to inquiry about their educational value. In studies of diverse authors [30]-[33], there are several answers to this question: mainly, it is seen that said tools have a key role in methodologies design for the process of teaching-learning and would solve many undesirable situations such as demotivation and isolation, among others.

But certainly, one of the hypotheses that is becoming more significant is their impact on the way of teaching and learning, as these resources based on interactivity generate new learning environments that benefit not only students but also teachers. Regarding students, these tools have a greater relevance in their learning process as they keep their own pace and develop a set of competences and abilities that will be useful for their life. All this derived from their collaborative work. Regarding teachers, on one hand these tools emphasize their role as mediators, and on the other hand, they contribute to the initial and permanent formation of teachers. This happens because some of the mentioned resources (social networks, cloud computing, blogs, etc.) are useful as channels to create learning communities through the network where content is created, organized and shared, and they promote communication [32], [33]. Summarizing, all tools here defined as collaborative type contribute to efficiency and effectiveness to the educational system in a general way.

2 Methodology

A methodology of mixed type was developed, which is validated by the scientific method in order to inquiry on incidence or interrelation of a reality or variables that due

to their condition need a qualitative and quantitative analysis. In this case, this consisted on the application of a questionnaire with Likert type rating-scale question, with closed and open questions to evaluate self-perception of teachers on their level of ICT collaborative tools and teaching practices used through said model.

2.1 Objectives and hypotheses

Objectives formulated for this work are hereunder indicated:

- Evaluating perception of knowledge level that secondary education teachers from Dominican Republic have on collaborative tools mediated by ICT.
- Identifying in which collaborative tools teachers have more mastery and in which ones they need more knowledge.
- Verifying if knowledge level of teachers varies depending on sex, center type, educational modality, educational area, location and professional experience.
- Determining if knowledge level of teachers in collaborative tools, professional experience and other sociodemographic variables have influence on design and application of these methodologies in classroom.
- Knowing the activities or resources most used by teachers for the development of collaborative methodologies mediated by ICT.

These objectives derivate from the following hypotheses:

H1=There are significant differences between the collaborative tool type and level of knowledge of teachers.

H2=There are significant differences between knowledge level of teachers depending on sex, center type, educational modality, educational area, location and professional experience.

H3=Level of knowledge of teachers on collaborative tools and other sociodemographic variables have influence on design and application of these methodologies in classrooms.

H4=There is a relation between collaborative experiences carried out by teachers on short and long term and type of center, educational area, sex, educational modality, professional experience and location.

2.2 Population and sample

The population of this research is found in the Dominican Republic, specifically from Santo Domingo, San Cristóbal and Villa Altagracia cities, as Fig. 1 shows.

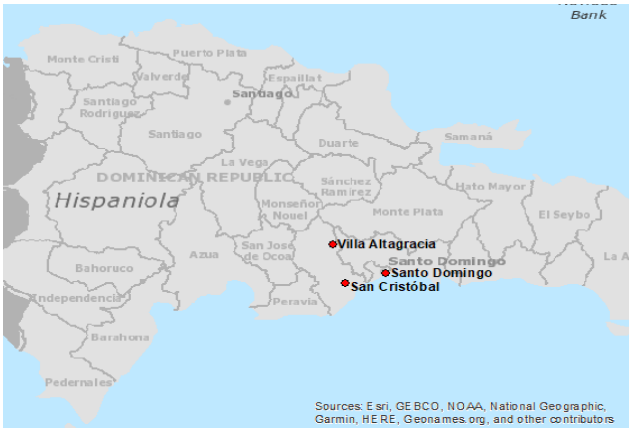

Fig. 1. Location of sampling cities

In the selection of the involved educational centers, a probability, representative sampling was carried out. The research included a population of 7800 teachers distributed in the aforementioned cities. From this universe, a sampling of 542 teachers from 17 schools was taken. A 57.7% corresponded to Santo Domingo, 21.8% belonged to San Cristóbal and a 20.5% belonged to Villa Altagracia. Sample represents 96% of confidence interval with a margin of error of 4% (see Table 1). Regarding the type of center, 83% of participants were from public centers and 17% from subsidized centers. Institutes where this study was applied had some type of ICT equipment.

Table 1. Study population and Confidence Interval

Variables	Population (N)	Sample (n)	Confidence Interval
Santo Domingo	4,556	355	95%
San Cristóbal	2,900	66	90%
Villa Altagracia	344	54	90%
Total	**7,800**	**542**	**96%**

2.3 Instrument

The instrument used is a questionnaire elaborated by the research group of the Universidad de Salamanca GITE-USAL [34] adapted for its application to teachers of technical-professional and high school modalities from the Dominican Republic. In order to validate the adapted instrument and verify its adequacy to the context, this was sent to 6 teachers from other centers, non-participants.

The questionnaire was composed by three parts. In the first one, there are nine questions prepared to obtain information about sociodemographic aspects. The second is oriented to know the knowledge level on collaborative tools, composed by 13 items with closed answers, using a Likert-type scale. Values ranges from 1 to 5, where 1 means very low and 5 very high. Third part is focused in examine the type of experiences that had been carried out in these contexts with students. Due to characteristics

of this part, the reliability analysis was carried out by means of the Cronbach's Alpha indicator, equal to 0.928, confirming that it is a very good construct and statistically correct [35]. Third part consists of 8 open and closed questions to collect experiences of collaborative work mediated by ICT carried out by teachers with their students (see Table 2). In order to perform a better analysis, it was necessary to close the first question of part three, meaning, change an open item to a dichotomous one [36], with two options as answer (yes or no). This aimed to contrast if teachers with a certain level of knowledge on collaborative tools were who designed and developed less of these methodologies. The instrument can be found at http://bit.ly/33LEJzU

Table 2. Description of instrument per dimension

Dimensions	Number of elements	Characteristics
Sociodemographic characteristics	9 items	Closed questions with continuous values
Level of knowledge on collaborative tools	13 items	Likert-type scale questions
Experiences of collaborative work through ICT with students	8 items	Open and closed questions

2.4 Procedure of data collection and analysis

In order to analyze the questionnaire, software R 3.6.1 and SPSS 21 were used. With the purpose of determine the normality of each variable, the Kolmogoroy-Smirnov normality test (KS) was used. In this case, the assumption of normality is not reached in any of the variables ($p<.001$).

Therefore, non-parametrical Mann-Whitney U and Kruskal-Wallis tests were applied, as appropriate.

In order to generate the contrast in level of knowledge on teachers and sex variable, the relation through the contingence table was explored. Additionally, in order to perform the analysis, it was necessary to previously carry out the weighted average of the tool dimension and create five categories (very low, low, medium, high and very high).

In addition, categorizations were established in order to analyze some open questions, patterns that repeated the most in questions where up to three answers could be chosen were selected and an open question related with teachers that had performed experiences of collaborative work through ICT was closed in order to generate an statistical contrasts.

3 Results

In the first place, level of knowledge of teachers on tools previously described were assessed and then, the interference of sociodemographic aspects was contrasted, and in second place, collaborative experiences that high school teachers have carried out with their students are analyzed.

3.1 Level of knowledge on high school teachers on collaborative tools mediated by ICT

At the time of analyzing all items of dimension tools of collaborative work, it is observed that level in teachers from technical-professional and high school modalities oscillates between medium and low concerning the use of ICT tools that facilitate co-operation. None of the items is over four points. However, a more exhaustive analysis indicates that some collaborative work tools are more used than others (see Table 3).

In that sense, tools in which teachers stated having a lower level of knowledge are, as it can be seen, wikis (X=1.89), educational robotics (X=1.90) and WebQuest (X=2.20). For example, regarding wikis, 57.7% of teachers expressed having a very low level in the management of this tool and barely a 5.5% admitted having a very high level.

In the case of the tools with higher level of knowledge, repositories of videos (X=3.77), social networks (X=3.68) and online audiovisual presentations (X=3.44) were found. From these, more than 50% of teachers declared having a high or very high level of knowledge. However, it is observed that the standard deviation is higher in one point for all cases, so competences between them is even more dispersed.

Table 3. Level of knowledge of teachers on tools and resources used for cooperation (n = 542)

Collaborative Work Tools	Very Low 1	Low 2	Medium 3	High 4	Very high 5	X	S_x
1. E-learning platforms	36.2%	17.5%	19.2%	16.1%	11.1%	2.48	1.401
2. Blogs	23.8%	18.3%	23.1%	22.3%	12.5%	2.82	1.352
3. Wikis	57.7%	16.1%	10.7%	10%	5.5%	1.89	1.254
4. WebQuest	46.9%	19.9%	14.4%	11.6%	7.2%	2.12	1.309
5. Social Networks	7.2%	7.2%	23.4%	34.7%	27.5%	3.68	1.160
6. Educational Robotics	56.8%	18.6%	10%	7.2%	7.4%	1.90	1.270
7. Office Automation	22.9%	18.1%	20.1%	23.1%	15.9%	2.91	1.399
8. Shared files	30.3%	19.7%	17.3%	18.5%	14.2%	2.67	1.433
9. Online audiovisual presentation	7.4%	13.7%	29%	27.1%	22.9%	3.44	1.193
10. Videoconferences	24.7%	18.3%	16.4%	21.6%	19%	2.92	1.465
11. Video repositories	5.9%	7.4%	22.9%	31.2%	32.7%	3.77	1.155
12. Online concept maps	45.4%	18.6%	14.6%	12.9%	8.5%	2.20	1.357
13. Shared photo albums	39.1%	21.6%	13.7%	15.9%	9.8%	2.36	1.385

Table 4. Table of contingence level of applications knowledge in accordance with sex (n = 542)

			Sex		
	Level		***Male***	***Female***	***Total***
Level of Knowledge	Very Low	% of total	0.20%	0.20%	0.40%
	Low	% of total	8.30%	19.40%	27.70%
	Medium	% of total	14.20%	21.40%	35.60%
	High	% of total	9.60%	15.30%	24.90%
	Very High	% of total	6.50%	5.00%	11.40%
Total		% of total	38.70%	61.30%	100.00%

Findings indicate that there is a statistically significant association between level of knowledge on collaborative tools in men and women $\chi^2 1;.05 = 13.241$; p =.002. It was observed that females had a competence level classified as medium-low in the management of said tools (67%), while males competence level is classified in a medium-high range (62%). These percentages are obtained after summing medium and low ranges in females and medium and high in males. The grade of relation found between these variables is rather moderate and relatively proportional (Contingency Coefficient= .154; p<.05) (see Table 4).

Mann-Whitney U test shows significant differences related to sex (z = -3163. p =.002). Male teachers are who expressed having a higher level of mastery in managing ICT tools for collaborative activities or projects.

It was also studied *if there were significant differences regarding management of ICT tools to develop collaborative methodologies in accordance with educational modality, type of center, between different centers and their location*. As in all cases, KS normality test was previously carried out. As p <.001, it is accepted the assumption that the variable does not have a normal distribution. Therefore, the nonparametrical Mann-Whitney U and Kruskal-Wallis tests are used based on variables.

Table 5. Level of knowledge on teachers from educational centers in accordance with the educational modality, type of center and area of the educational center (n = 542)

Variables		Mean Rank MR	Mann- Whitney U	Z	Sig.
Educational Modality	Technical-professional	272.58	34041	-.208	.835
	High School	269.69			
Type of center	Public	271.35	20634	-.048	.962
	Subsidized	272.21			
Area of center	Urban	257.53	23228	-1.09	.276
	Rural	257.53			

Table 6. Level of knowledge on collaborative tools in accordance with location of educational centers (n = 542)

Location of the center	Mean Rank (MR)	Chi-Square	Sig.
Santo Domingo	256.77	25.258	**p<.001**
Villa Altagracia	337.76		
San Cristóbal	248.23		

Data indicated that there are not significant differences between level of knowledge of teachers from technical-professional and high school modalities (p=.267). Similarly, it is verified that there is not a relation between belongingness to a certain type of center (public or subsidized), and the level of acquired competences on the technological tools indicated before (p=.059). Also, there are not differences regarding the area of the centers (p=2.76) (see Table 5). However, there are significant differences regarding location and level of knowledge. Post-hoc tests and average ranges indicate that those differences do exist between Villa Altagracia and San Cristóbal teachers, and Villa

Altagracia and Santo Domingo (p <.001). Teachers from Villa Altagracia are who have a better perception about having a high level of knowledge, while teachers from San Cristóbal express having a lower level of mastery of these tools (Tables 6 and 7).

Table 7. Multiple Comparison about center location and level of knowledge (n = 542)

(I) Center Location	(J) Center Location	Mean Difference (I-J)	Standard Error	Sig.	95% Confidence Interval	
Santo Domingo					Lower Bound	Upper Bound
	Villa Altagracia	-.52084*	.10431	p<.001	-.766	-.2757
	San Cristóbal	.04682	.102	.890	-.1929	.2865
Villa Altagracia	Santo Domingo	.52084*	.10431	**p<.001**	.2757	.766
	San Cristóbal	.56766*	.12485	**p<.001**	.2742	.8611
San Cristóbal	Santo Domingo	-.04682	.102	.890	-.2865	.1929
	Villa Altagracia	-.56766*	.12485	p<.001	-.8611	-.2742

There were significant differences among educational centers too (p<.001). Specifically, post hoc tests detected 6 different groups, of which one of them is not homogeneous. In addition, it is observed that educational centers with the highest weighted average are mostly from Villa Altagracia (see Table 8).

Table 8. Multiple comparison of level of knowledge on collaborative tools in accordance with the educational center (n=542)

Educational Centers	1	2	3	4	5	6
High School Cambita	1.77					
Polytechnic school Félix Pepen	2.18	2.18				
Polytechnic school Fabio Amable Mota (Arts)	2.38	2.38	2.38			
Salesiano Technical Institute	2.41	2.41	2.41			
High School Perp. Socorro	2.52	2.52	2.52	2.52		
Polytechnic school Simón Orozco		2.61	2.61	2.61		
Polytechnic school Fabio Amable Mota (General)		2.69	2.69	2.69	2.69	
High School Feliz Evaristo Mejía		2.74	2.74	2.74	2.74	
Polytechnic school Loyola		2.75	2.75	2.75	2.75	
Polytechnic school Cambita		2.93	2.93	2.93	2.93	*2.93*
High School Gregorio Ever Crispín		2.96	2.96	2.96	2.96	*2.96*
High School San Rafael		2.97	2.97	2.97	2.97	*2.97*
High School Manuel del Cabral		3.00	3.00	3.00	3.00	*3.00*
High School Tavárez Justo			3.11	3.11	3.11	*3.11*
Polytechnic school San Vicente de Paul				3.30	3.30	*3.30*
Polytechnic school Nuestra Sra. de la Altagracia					3.47	*3.47*
High School El Caobal						*3.66*
Sig.	.123	.056	.160	.077	.082	.153

On the other hand, in order to contrast *the relation regarding years of experience of teachers and level of knowledge on collaborative work tools* the normality of variables was verified. It was determined that there was not a normal distribution (p<.001), therefore, it was decided to perform Kruskal Wallis test. This test shows that there are significant differences in certain groups (p<.001) (see Table 9).

It is seen that weighted averages and weighted ranges vary in each case, especially in the last group (more than 20 years), where the lowest value is observed (MR=188.52). In contrast, data suggest that teachers with less experience have a higher range of competence than the rest of the teachers (MR=301.22). With this, it is verified that personal experience has an influence over level of knowledge of teachers (see Table 9). Since there are significant differences between teacher experience and level of knowledge on collaborative tools, it is necessary to do post hoc tests of multiple comparisons with the purpose of verifying in which groups these significant differences are presented.

Table 9. Analysis of knowledge level on teachers and its relation with years of experience (n=542)

Years of Experience	Mean Rank MR	Chi2	Sig.
<10 years	301. 22	41.291	**p<.001**
From 10 to 20 years	288.13		
More than 20 years	18..52		

The multiple comparisons post hoc test was carried out with a confidence interval of 95%. On it, it is possible to observe that there are significant differences in level of knowledge on collaborative tools mediated by ICT between teachers with more of 20 years of professional experience and the rest of the groups (p<.001). It is this group who has less knowledge, as it has been previously stated. Regarding the rest of the groups, it is observed that there are not significant differences (teachers with less of 10 years of experience and 10 to 20 years). Although it exists a few differences of weighted averages ranges, those are not significant (p=.533) (see Table 10).

Table 10. Multiple comparisons of level of knowledge and years of professional experience with post hoc test (n = 542)

(I) Professional Experience	(J) Professional Experience	Mean Difference (I-J)	Standard Error	Sig.	95% Confidence Interval	
					Lower Bound	*Upper Bound*
Less than 10	From 10 to 20	.09773	.09135	.533	-.1169	.3124
	More than 20	.69357*	.1117	p<.001	.4311	.9561
From 10 to 20	Less than 10	-.09773	.09135	.533	-.3124	.1169
	More than 20	.59584*	.10541	p<.001	.3481	.8436
More than 20	Less than 10	-.69357*	.1117	p<.001	-.9561	-.4311
	From 10 to 20	-.59584*	.10541	p<.001	-.8436	-.3481

3.2 Experiences of teachers on ICT collaborative work with students.

When teachers were asked about their experience on collaborative work experience mediated by ICT with their students, a 52% expressed not having carried out any collaborative experience, compared with the 48% that did have developed some collaborative work in their teaching practices.

Within that percentage of teachers that had developed that type of experience, it was explored if the fact of having carried out any type of collaborative activity had influence on their knowledge level. Although results show signification, it was determined that there are not correlations between these variables (p=.069). Significant experiences do exist in case of sex (p=.034) and professional experience (p=.002). Women have carried out more collaborative experiences than men, and the most experienced teachers have performed more collaborative activities than novice teachers (less than 10 years and between 10 and 20 years) (Table 11, 12 and 13).

Table 11. Relation between level of knowledge of teachers, experience of collaborative work and sex (n = 256)

Variables		Mean Rank	Mann- Whitney U	Z	Sig.
Collaborative Experiences	Yes	258.66	33324	-1.820	.069
	No	283.16			
Sex	Male	255.97	31598	-2.123	**.034**
	Female	281.33			

Table 12. Relation between collaborative work experience and professional experience (n = 256)

Professional Experience Years	Mean Rank MR	Chi-Square	Sig.
Less than 10 years	253.65	12.718	**.002**
From 10 to 20 years	266.63		
More than 20 years	310.17		

Table 13. Multiple Comparison about experience on collaborative work and professional experience (n = 256)

(I) Professional Experience	(J) Professional Experience	Mean Difference (I-J)	Standard Error	Sig.	95% Confidence Interval	
					Lower Bound	*Upper Bound*
Less than 10	From 10 to 20	-.048	.048	.585	-.16	.07
	More 20	-.209*	.059	.001	-.35	-.07
From 10 to 20	Less than of 10	.048	.048	.585	-.07	.16
	More than 20	-.161*	.056	.012	-.29	-.03
More than 20	Less than 10	.209*	.059	***.001***	.07	.35
	From 10 to 20	.161*	.056	***.012***	.03	.29

Regarding type of experiences, it is observed that they were performed from different perspectives; whether for the assignation of specific tasks or the performance of long-term collaborative projects. Considering those criteria, experiences in short and long term were divided. Short-term is referred to those activities or experiences that have a duration of 1 to 5 days. Long-term experiences can be developed for more than five days; therefore, more time of commitment and monitoring was required comparing them with short-term experiences. The most used type of experience in the short-term is presentations of group tasks (11.2), while in long-term, learning based on projects (24.4%) was the most used type. (see Table 14).

Table 14. Experiences and/or activities of collaborative work using ICT carried out by teachers with their students in the short and long-term (n = 256)

Short term	Experiences and Activities	n	%
	Classroom collaborative work	2	0.8%
	Assignation and reception of homework (Google Docs, E-mail, Social Networks etc.)	21	8.1%
	Resources Search on Internet	6	2.3%
	Classes via Streaming	1	0.4%
	Computers Configuration	2	0.8%
	Debates or Discussion Forums	22	8.5%
	Online evaluation	1	0.4%
	Virtual Exam	2	0.8%
	Group presentations	29	11.2%
	Project Fairs	1	0.4%
	Robotics Programming	1	0.4%
	Flipped Classroom	11	4.3%
	Machine repairing	2	0.8%
Long Term	Learning based on problems	15	5.8%
	Learning based on projects	63	24.4%
	Shared Files	3	1.2%
	Workshop Course	3	1.2%
	Developing of a team topic	45	17.4%
	Design of Activities	3	1.2%
	Formulation of topics on groups	10	3.9%
	Reciprocal Teaching	1	0.4%
	Work teams	10	3.9%
	Puzzles	1	0.4%
	Mentorships	3	1.2%

Table 15. Collaborative experiences carried out by teachers in the short- and long-term (n = 256)

Variables	Term of the experience	Mean Rank MR	Mann-Whitney U	Z	Sig.
Type of center	short-term	130.06	7997	-.146	.884
	long-term	129.11			
Area of the center	short-term	128.14	7912	-.328	.743
	long-term	130.45			
Sex	short-term	125.87	7671	-.76	.447
	long-term	132.03			
Educational Modality	short-term	134.98	7475	-1.165	.244
	long-term	125.68			
Professional Experience	short-term	127.11	7802	-.471	.638
	long-term	131.17			
Location of the center	short-term	128.47	7947	-.206	.837
	long-term	130.22			

Significant differences were not found regarding collaborative experiences carried out by teachers in the short and long-term in accordance with the type of center, area, sex, educational modality, professional experience and location of the center ($p>.05$) (see Table 15).

On the other hand, when teachers were asked about ICT and the added value they provide for the student to develop collaborative projects: barely a 6% considered that ICT do not provide any value, while 96% expressed that ICT are very useful for developing collaborative projects with students.

Teachers that answered positively argued that contributions of this type of experience are related with cognitive development, emotional and psychological development, ethical and academic aspects. Within these variables, cognitive development, emotional and psychological aspects are the most valued elements with a 41% each, while ethical aspects are the least mentioned (8%). It is important to highlight that regarding cognitive development, most of the teachers stated that this teaching model facilitates learning and develops ICT skills. Additionally, in the case of psychological aspects mentioned, an increase in motivation, development of creativity, interactivity and social skills were mentioned, among others, as Fig. 2 shows.

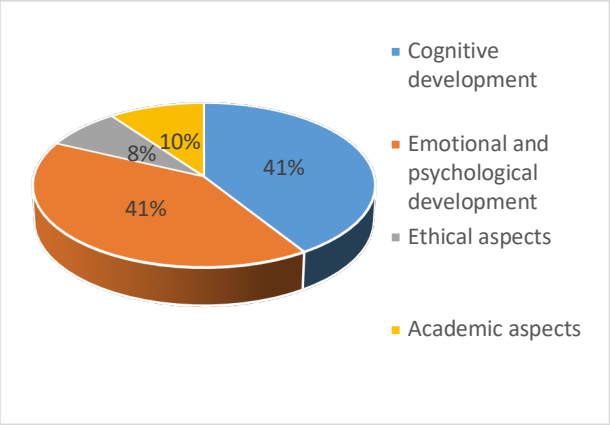

Fig. 2. Contributions of experiences using Collaborative Learning Methodologies mediated by ICT (n = 256)

However, when asking teachers about approximated time spent in carrying out this type of activities with their students, 52% claimed that they perform collaborative activities occasionally, equivalent to once a month, or every two or three months, and only 8% of teachers usually perform them, meaning, daily, as Fig. 3 shows.

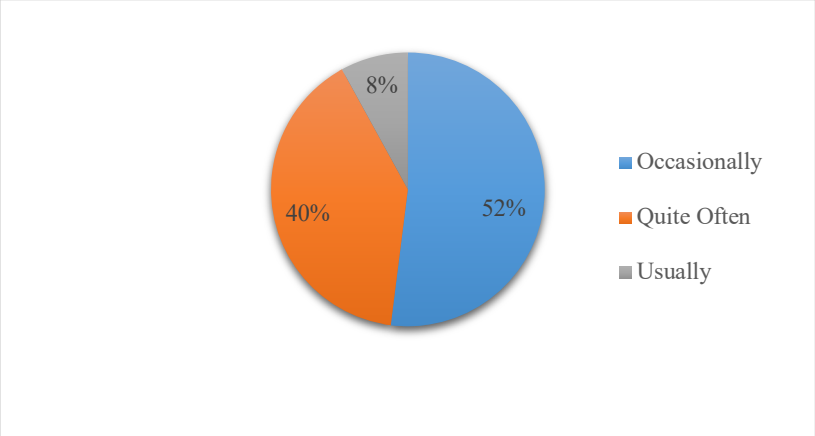

Fig. 3. Approximated time dedicated by teachers to the performance of collaborative activities with ICT with students (n = 256)

Concerning activities and resources usually used to promote collaborative work with ICT in their students, results point out to the resources search on Internet as the most usual activity among teachers (33%). Nevertheless, there is little difference margin comparing it with project works (32%). It is also observed other very popular resources such as problem solving (20%) and elaboration of topics in groups (16%). On the other hand, the least used resources are wikis (1%) and others (0.6%), where there are activities like websites design, concept maps and e-books (see Table 16).

Table 16. Resources and/or activities used by teachers on a regular basis.

Resources used on a regular basis	n	Percentage
a) Learning based on projects	172	32%
b) Problem solving	110	20%
c) Elaboration of topics in groups	88	16%
d) Resources search on Internet	178	33%
e) Tasks on WebQuest	13	2%
f) Forum debates	30	6%
g) Wikis created by groups or the whole class	6	1%
h) Groups blogs	35	6,5
i) Glossaries elaboration	9	2%
j) Tasks on Social Networks	81	15%
k) Participation on games	11	2%
l) Others	3	0.6%

Concerning criteria of teachers to arrange groups and distribute tasks, 35% arrange heterogeneous groups composed by student of diverse characteristics as sex, age, different abilities, etc., which contribute with great cognitive richness by said diversity. In the opposite case, a 5% prefer alphabetical order (Fig. 4).

It can be observed in block 7.1. (Table 17) that 64% of teachers prefer evaluating the process and result, instead of the process or result alone. Similarly, a 67.8% chooses to evaluate each of their students instead of evaluating her/him jointly as it can be seen in block 7.2. However, barely a 39.9% of teachers use ICT in the evaluation process (block 7.3; see Table 17).

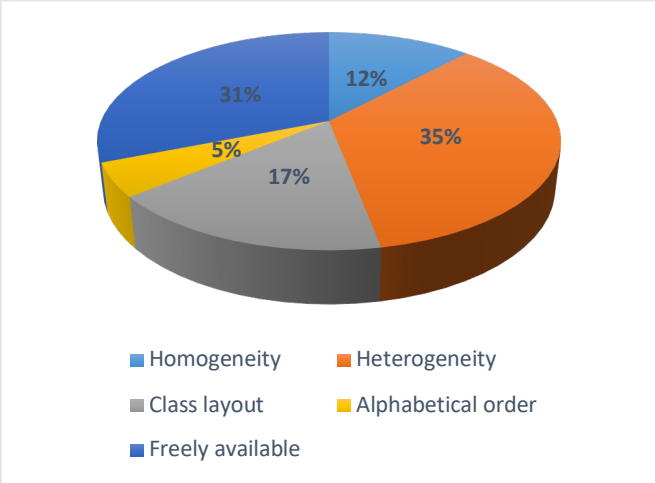

Fig. 4. Criteria used by teachers to arrange groups (n = 256)

Table 17. Criteria of teachers to evaluate groups (n = 256)

Blocks	Items	%
7.1	7.1.1. Evaluated result	27.5
	7.1.2. Evaluated process	0.5
	7.1.3. Evaluated process and result	64
7.2	7.2.1. Evaluated the whole group	32.2
	7.2.2. Evaluated each of the students	67.8
7.3	7.3.1. Used ICT in the evaluation process	39.9
	7.3.2. Didn't use ICT to evaluate	60.01

In the case of other evaluation criteria of teachers, two categories have been created depending on their characteristics: First one is referred to behavioral aspects that teachers consider evaluating, and the second one is referred to the educational aspects the teacher follows. In both cases, attitude, teamwork and self-evaluation are highlighted over other categories, and the rest of them are very distributed between them. Nonetheless, if particular categories are analyzed, it is observed that 64% of teachers evaluate educational aspects, and only 36% value behavioral aspects. Despite of it, everything indicates that teachers aim to all their students to get involved in collaborative activities and act in a proper manner in their development (see Table 18).

Table 18. Other evaluation criteria indicated by teachers in frequency and percentages (n = 256)

Behavioral Aspects	Attitude and teamwork	8%
	Fellowship	4%
	Behavior and responsibility	4%
	Effort	4%
	Self-confidence	4%
	Involvement of all students	4%
	Leadership	4%
	Respect	4%
Total conceptual aspects		**36%**
Educational Aspects	Self-evaluation	8%
	Interpretation ability	4%
	Development and showing of their abilities and skills in their competences	4%
	Role of every student	4%
	Oral tests	4%
	Abilities	12%
	Interaction and performance	4%
	Humanistic evaluation	4%
	Group interactivity	4%
	Originality	4%
	Criteria speed	4%
	Evaluation rubrics	4%
	Self, peer and hetero evaluation	4%
Total educational aspects		**64%**

Finally, based on teacher experience on collaborative methodology mediated by ICT, one to three aspects they agreed on were indicated: Those statements were related with benefits of said methodologies. Findings show that 88% do not reach proposed objectives. In the same way, 50% believe these methodologies improve the comprehension of concepts and processes studied, while the other 50% did not agreed on this matter. The most valued benefit by teachers is the acquisition of social skills, such as respect, fellowship, teamwork, etc. (59%), as Fig. 5 shows.

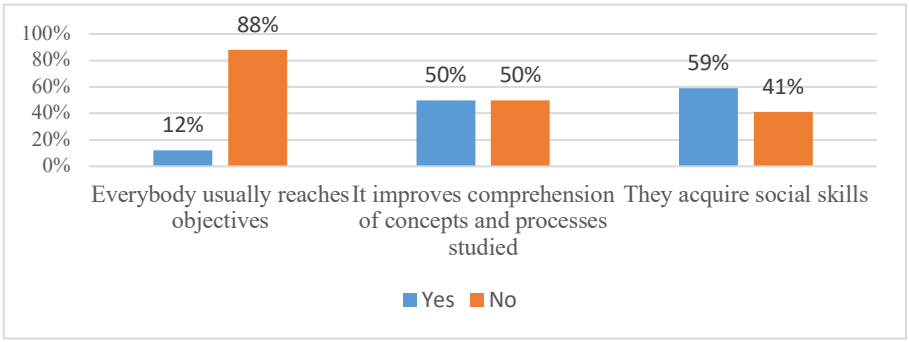

Fig. 5. Benefits of collaborative activities with ICT in accordance with teacher experience (n = 256)

4 Discussion

After having performed this study, general findings determined that teachers of secondary level (high school and technical professional education) of Dominican Republic require a better formation on ICT tools for cooperation. Some conclusions and topics to debate are hereunder proposed, according to objectives of our research.

Regarding first objective, "*Evaluating perception of knowledge level that secondary education teachers from the Dominican Republic have on collaborative tools mediated by ICT*", it was found that teachers have a low-medium level in the management of said resources. Accordingly, in line with the second objective, "*Identifying in which collaborative tools teachers have more mastery and in which ones they need more knowledge*", teachers expressed having a higher level of competence in the use of video repositories, social networks and online audiovisual presentations, while wikis, educational robotics and WebQuest were the most unknown resources for them. Therefore, H1 is met: *There are significant differences between the collaborative tool type and level of knowledge of teachers*. In addition, this confirms that formation given to teachers in this context does not contemplates technological tools to promote collaborative learning methodologies [37].

Concerning third objective, "*Verifying if knowledge level of teachers varies depending on sex, center type, educational modality, educational area, location and professional experience*", H2, "*There are significant differences between knowledge level of teachers depending on sex, center type, educational modality, educational area, location and professional experience*" is partially met, since there were only significant differences regarding sex, location and professional experience. In the case of sex, there is evidence confirming a digital gap between men and women, where the first ones had more advantages. For example, 62% of men indicated having a medium-high level in the management of said resources, while 67% of women expressed having more difficulties, and their knowledge level is medium-low. In consequence, it can be said that digital gap exists not only between students and teachers but is also produced between teachers of different sex [13]. These significant differences between both groups are a matter of concern, as they indicate a disproportion in level of knowledge of female and male teachers of secondary and high school in different modalities. Although this study does not allow making any generalization because it was developed in a specific context, as the approach was, we cannot ignore that this situation is not only given in this context, but it is an inequality trend of the society on the knowledge per sex reflected in many countries of the world [2], [3], [38].

There is a theory indicating that this digital gap can be produced by an attitude problem between these figures, but in recent studies [39], [40], significant differences in the attitude of men and women were not found. Therefore, we opt for the idea of ICT access inequality, which is more than evident in many Latin American countries. This is the reason why a greater commitment from state authorities is requested, as they must make from this necessity a national problem [38], [41].

Regarding type of center, educational modality and area of the center, no significant differences between both groups ($p>.005$) were found. However, when level of knowledge was contrasted with location and between centers, differences were indeed

significant (p<.001). Teachers from Villa Altagracia had a greater perception in the mastery of technological collaborative tools than teachers of Santo Domingo and San Cristóbal, being the last group who indicated having the lowest level. However, if we pay attention to knowledge level between centers, the same locality has teachers with very low knowledge levels in one school, but in other centers they have very high levels, as in the case of San Cristóbal. These results contrast with a similar study performed at national level in primary and secondary schools of the Dominican Republic, where Santo Domingo and Santiago were the cities that obtained the best results in management and integration of ICT [42].

The low and high level of knowledge on technological collaborative tools between centers of the same locality indicate that there is not collaboration between colleagues out of their educational centers to improve their professional formation. Regular meetings recorded are curricular updating workshops carried out within the cities, usually once a year, before the starting of a school year [10], [43]. Obviously, the time spent on it is very scarce considering that professional learning of teachers is a permanent process within formal and non-formal context, but that is also nurtured from daily interactions with colleagues and students [44].

Findings also showed differences between level of knowledge and professional experience (p<.001). As a conclusion, it is possible to say that professional experience has an influence over the competence of teachers. The greater the professional experience, the lower the capacity of mastery and management of collaborative tools. In that way, in Latin American countries there is a trend towards professional burnout and a great shortage in initial-continuous formation in teachers due to redistribution of resources, scarce institutional support and a lack of correlation between formation and practice [45] [46]. This situation generates that the most veteran teachers are not able to reach enough competences to efficiently comply with their labor. In the case of the Dominican Republic, we think that the corresponding Ministry has neglected the permanent formation of the most experimented teachers in order to prioritize classroom creation, or rather there is a decay of the profession in said group that causes them to have a reticent attitude to learn and incorporate these resources in classroom [11].

Findings of this research differs with a study carried out [47], that found out that teachers with more than 20 years exercising teaching are who know these tools to a larger extent. This research was carried out in Spain, so it allows to observe the competence level on teachers, which varies depending of the context.

Fourthly, it was intended *to determine if the level of knowledge on technological collaborative tools, sex and professional experience has influence on design and application of these experiences, and know resources used by teachers for these activities.* Results show that there is not a significant link between knowledge level and the use of collaborative methodologies, because someone who had carried out any activity with technological resources not necessarily had a greater level of competence (p=.069). For example, it was verified that teachers with more professional experience have performed these activities at a larger extent (p=.002) despite they are who have less competence. It is believed that novice teachers still do not have enough professional baggage to perform these projects, since they feel they have a knowledge level rather high.

It was also found significant differences depending of sex, where women are who have carried out more collaborative experiences than men, despite having a lower level of knowledge, as it was already stated (p=.034). These findings indicate that H3 is almost totally met. Only one idea is rejected: that level of knowledge of teachers has influence over the application of collaborative experiences (p=.069).

On the other hand, when researched on collaborative experiences mediated by ICT carried out with students, it was verified that only 48% of teachers had performed some type of collaborative activity, and, from that small percentage, barely an 8% usually performed them. This corroborates the proposition that ICT are infrequently used in practices of the Dominican Republic' teachers, thus, in collaborative methodologies [7], [42].

Concerning time spent on activities of "*short or long-term*", it is noticed that when teachers decide on implementing Collaborative methodologies, 60.8% prefer performing long-term experiences. Additionally, 94% indicates that ICT are an add value for collaborative experiences. Within their contribution, an increase in motivation, learning development, optimization of time, development of creativity, among others, are highlighted, as it can be seen in other studies [18], [48]. In addition, H4 is rejected and theory that there is a relation between collaborative experiences carried out for teachers in the short and long term and previously described sociodemographic variables is refuted, as significant differences among them were not found (p>.005).

Regarding fifth objective, "*knowing activities or resources teachers use for the development of collaborative methodologies*", learning based on projects is the most performed activity (32%), while other resources and methodologies like WebQuest (2%) and Wikis (1%) are barely used because the knowledge level on these tools is very low.

Criteria that are most used by teachers in order to arrange these activities in the creation of groups is heterogeneity (35%), but also free choice of their students (31%). From these, first criterion is the most favorable to guarantee diversity and equity because the second criterion let students to choose in a discriminatory manner due to affinity, isolating the most vulnerable [49].

In relation with evaluation criteria, approximately 60% of teachers do not use ICT to evaluate, and 64% evaluates educational aspects, differently from the 36% that evaluate behavioral aspects. It is hardly surprising that 88% of teachers consider that not all students of the group usually reach objectives, as in order to achieve this purpose, it is necessary to consider communicational processes developed in virtual environments and possibilities offered by ICT for the E-evaluation (self-evaluation, peers evaluation, feedback, synchronous and asynchronous monitoring of activities, among others) [50].

5 Conclusion

As a conclusion, it is noticed that one part of teachers does not frequently use collaborative methodologies mediated by ICT in their teacher practices or for their self-formation because they do not have adequate knowledge. This is why it is stressed on the "institutional support to teachers", so that they can form in competences focused in the ICT use, which can contribute in the reduction of the digital gap, development of

collective competences of learning and the improvement in the students quality index [3], [13], [18], [51] - [53].

Regarding limitations of this study, it is mandatory to mention the good will of some administrators so that their centers could participate and, on the other hand, the long waiting time to retrieve questionnaires, since we had to attend in several occasions to some centers and press teachers to fill the instrument as they did not have enough time. Concerning strengths, it is mandatory to say that it was possible to access to a varied population, multidisciplinary and representative of the study population. Results obtained have been useful to design a formative proposal given to teachers of said population. Results of said proposal will be available in future publications. We hope this research might be useful to give orientation to educational entities about formative necessities previously mentioned aiming to refocus already existing policies.

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7 Authors

Rosalba Acosta Corporán Presently working as PhD in the Programme Education in the Knowledge Society, University of Salamanca and in the GRIAL research group the same university. She has published 2 number of papers in internationals journals and presented 4 papers in international conferences. The research area is Collaborative Learning Methodology in education. Email: u139132@usal.es

Jorge Joo-Nagata PhD of the Program on Education in the Knowledge Society University of Salamanca. Now, he has working as professor in University of Educational Sciences (Santiago de Chile). He has published more than 10 numbers of papers in international journals and presented many conferences. His research interests are technologies applied to the study of the territory, GIS and geomatics tools in educational contexts. Email: jorge.joo@umce.cl

Antonio Víctor Martín García Professor, Ph.D. at the University of Salamanca (Spain). Member of the Group "Educational Processes, Spaces and Practices". Director of the Official Master "Advanced Studies of Education in the Global Society" of USAL. Extraordinary Doctorate Award in 1992. He is the author and / or co-author of several books, all of them focused from the perspective of adult education and educational gerontology. Also, he is specialist in blended learning, member of the Editorial Committee of several journals of scientific journals and reviewer / evaluator of other journals. Email: avmg@usal.es

Azucena Hernández Martín Professor Ph.D. at the University of Salamanca (USAL). Professor in the degrees of Pedagogy and Social Education at the USAL, and also of master's ICT in Education, forming part of its academic and quality commission. Specialist in teacher training. She works for the Department of Didactics, Organization and Research Methods and is Vice Dean of Student Mobility (USAL). She has published more than 40 numbers of papers in international journals. Email: azuher@usal.es

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