

Digital collaborative learning in elementary and middle schools as a function of individualistic and collectivistic culture: The role of ICT coordinators' leadership experience, students' collaboration skills, and sustainability

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Abstract

The purpose of this study was to examine the influence of online collaborative learning experiences on students' digital collaboration skills and on the sustainability of e-collaboration in schools' culture—comparing individualistic versus collectivistic cultures. In addition, we explored how the leadership experience of schools' ICT coordinators was predicted by their sense of professionalism and cognitive, emotional and social aspects of perceived learning (PL), while leading the collaborative projects. The participants were ICT coordinators from 513 Israeli schools; 214 of whom were Hebrew-speakers, and 299 Arabic-speakers. The participants were asked to complete an online questionnaire, which included multiple-choice and open-ended questions. The results showed significant differences between a variety of the coordinator-related variables as a function of learning culture (more individualistic vs. more collectivistic). Coordinators' leadership experience was a powerful predictor of students' digital collaboration skills, but did not predict the sustainability of e-collaboration. Coordinators' emotional PL predicted the sustainability of collaboration in both schools with more individualistic and with more collectivistic learning cultures. The implications of the findings for educational theory and practise are discussed.

KEY WORDS

cognitive, emotional, and social perceived learning, ICT school coordinators, individualistic and collectivistic school culture, leadership experience, online collaborative learning, students' digital collaboration skills

1 | INTRODUCTION

One of the aims of the educational system in the 21st century is to prepare students to successfully function in the knowledge society. This requires, among other things, developing the ability to interact, collaborate, and work in teams within digital environments (Dery, Sebastian, & van der Meulen, 2017). Collaborative learning involves groups of learners working together to complete a shared task or create group outcomes (Laal, Naseri, Laal, & Khattami-Kermanshahi, 2013). In this process, learners are exposed to different perspectives

and take responsibility for each others' learning, which results in higher achievement and greater productivity (Johnson & Johnson, 2009; Laal & Laal, 2012).

Information and communication technologies (ICT) have taken an increasingly important role in collaboration processes in educational systems (Fu & Hwang, 2018). In computer-supported collaborative learning (CSCL), digital devices support mutual construction of meaning. Alongside the acquisition and construction of knowledge, CSCL contributes to inter-personal interactions, which are the main drivers of the collaborative learning process (Fu & Hwang, 2018; Persico,

Pozzi, & Sarti, 2010; Rodríguez-Triana, Martínez-Monés, Asensio-Pérez, & Dimitriadis, 2015). Vygotsky (1978) argued that social interaction, language, and culture are the essence of meaningful learning. The 'Zone of Proximal Development' (ZPD) concept suggests that meaningful learning occurs when children's spontaneous ideas and understandings meet the requirements of the order and logic of adult thinking (Vygotsky, 1978). In addition, one of the important social-constructivist arguments is that understanding is constructed through authentic learning, when students participate in activities relevant to their lives (Woo & Reeves, 2007).

Interactions with the teacher and other learners are crucial in motivating students' efforts to learn in digital environments, as well as in promoting their satisfaction, enhancing learning processes, and improving learning outcomes (Cobb, 2009; Sung & Mayer, 2012). Studies on CSCL, or online collaborative learning, mostly focus on the benefits or challenges of this learning method and its impact on the academic, psychological, and social outcomes of students (Blau & Caspi, 2009; Barak, 2007; Xiong, So, & Toh, 2015). Only few studies have explored the contribution of technology-enhanced collaboration to teachers' leadership and professionalism. Having teachers orchestrate CSCL is crucial to the success of online collaboration scenarios. They can regulate and monitor the learning scenario and increase their awareness of the learning process and students' work (Rodríguez-Triana et al., 2015). The ICT coordinators' role is wide: they are expected to be 'technological leaders', 'pedagogical-technological experts', to be organizationally knowledgeable, and, in addition to teaching, hold middle management positions in their schools. The leadership skills of ICT coordinators are crucial in order to promote educational innovations in their organizations (Avidov-Ungar & Shamir-Inbal, 2017). From a pedagogical point of view, the coordinators can guide teachers to lead and facilitate e-collaboration, monitor its progress, encourage their students and provide them with prompt feedback (Laal & Ghodsi, 2012; Pozzi, Manca, Persico, & Sarti, 2007). Therefore, ICT coordinators hold the key role of teachers who are 'agents of change' in the integration of online collaborative learning in schools (Devolder, Vanderlinde, van Braak, & Tondeur, 2010).

Online collaborative learning, is a fundamentally socio-cultural phenomenon, which is influenced by cultural differences in the use of ICT in learning (Anderson, 2017) and affected by the attitudes and subjective norms of cultural collectivism (Arpacı & Baloğlu, 2016). For instance, Arpacı (2015), who examined the impact of cultural differences on the adoption of mobile learning in Canada and Turkey, found that there is a strong relationship between culture and adoption behaviour. Similarly, Deng, Benckendorff, and Gannaway (2019) recently claimed, that online learning, such as in Massive Open Online Courses (MOOCs), is designed according to the Western knowledge tradition, which negatively affects non-Western learners. Effective online teaching, according to Deng and colleagues, will lead to reduced gaps arising from differences in socio-demographic variables and cultural backgrounds.

In the context of the current study, conducted in Israel, the Hebrew-speaking population is characterized by a more individualistic cultural perspective, whereas Arabic-speaking groups are characterized by a more collectivistic culture (Ben-Zion, Mahajna, Bogaire, & Shavit, 2007).

Since, in order to learn in their own language, these groups mostly learn separately—in either Hebrew-speaking or Arabic-speaking schools, the cultural differences may impact collaborative learning processes.

The educational system in Israel consists of two separate subsystems, each catering for the needs of a distinct ethnic sub-population: The Jewish population studies in Hebrew-speaking schools, whereas Arabic-speaking Muslims, Christians, Druze, and Bedouin students learn in their native language in Arabic-speaking schools (Zuzovsky, 2010). Although the two cultural groups are constantly gradually evolving, they differ in various ways from each other, for example in the prominence of individualism and collectivism in their learning cultures (Addi-Raccah & Grinshtain, 2016; Sagiv, Orr, Bar-On, & Awwad, 2001). Arabic-speaking schools are characterized by collectivistic notions that underlie Arab society (Addi-Raccah & Grinshtain, 2016). This difference enables comparisons between the populations in our study.

1.1 | Research goals and questions

The present study explored the implications of online collaborative learning projects in elementary and middle schools that maintain different levels of online communication within the teaching staff and between teachers, students, and parents, as a function of culture. As mentioned above, Hebrew-speaking schools are characterized by a more individualistic culture, whereas Arabic-speaking groups hold a more collectivistic culture. In addition, we aimed to understand which variables predict students' digital collaboration skills and the sustainability of collaboration in the schools' culture, as well as which ICT leader-related variables, such as coordinators' leadership experience, professionalism and perceived learning (PL) when leading the collaborative project, add to this prediction.

The concept of PL refers to retrospective self-evaluation of the learning process (for review see Blau & Caspi, 2008; Caspi & Blau, 2008, 2011). *Cognitive PL* refers to the sense that new knowledge is acquired and new understanding is constructed. *Emotional PL* is the degree to which the learning process was interesting or boring, easy, or difficult. *Social PL* is the level of enjoyment from interpersonal interactions during the learning process. This research adds to the literature by exploring different aspects of PL in the retrospective evaluation of learning while leading a collaborative project in schools, that is, *learning by leading others*. This is in contrast with previous studies that used retrospection on learning by doing/gamification (Barzilai & Blau, 2014), or learning a lesson, topic, academic course, that is, learning from an expert/learning materials/technology (Blau & Caspi, 2008; Blau, Shamir-Inbal, & Avdiel, 2020; Caspi & Blau, 2008, 2011).

The relationships between the variables explored in this study are summarized in Figures 1 and 2. School-related variables predict the coordinators' experience of leading the collaborative projects, the level of their professionalism and different aspects of PL. These in turn, predict students' digital collaboration skills, and the sustainability of collaboration.

The research questions explored in this study were:

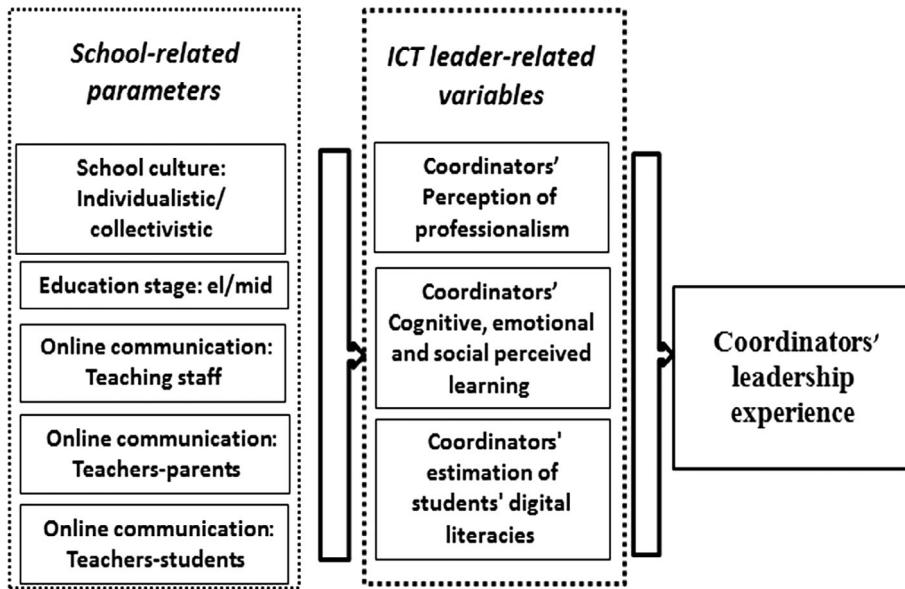


FIGURE 1 The research model forRQ2

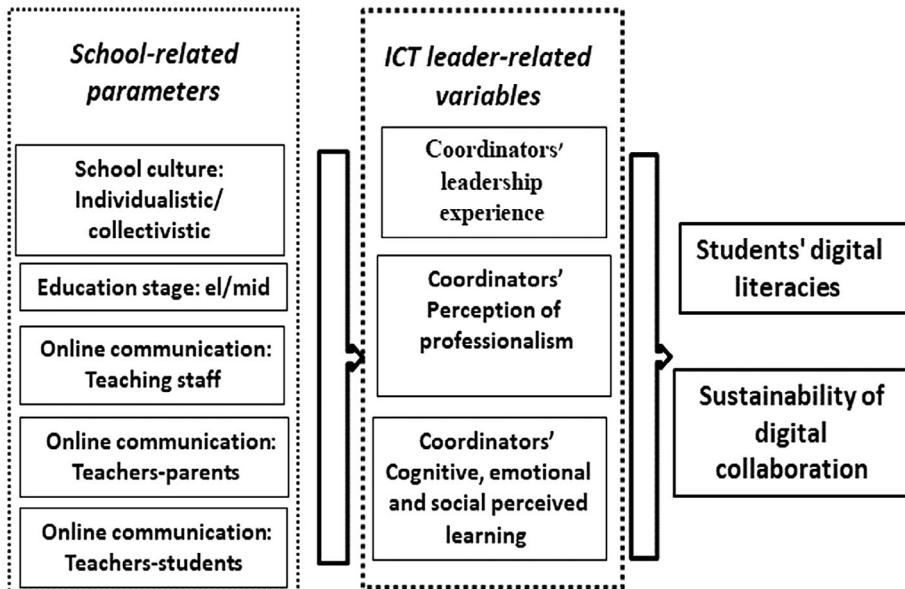


FIGURE 2 The research model for RQ3 andRQ4

RQ1 : Which school-related parameters and ICT leader-related variables differ as a function of *culture* (*individualistic* vs.*collectivistic*) in the context of digital collaboration?

RQ2 : How is *ICT coordinators' experience of leading digital collaboration* predicted by school-related parameters, and what do other ICT leader-related variables add to this prediction?

RQ3 : How are *students' digital collaboration skills* predicted by school-related parameters and what do ICT leader-related variables add to this prediction?

RQ4 : How is the *sustainability of digital collaboration* predicted by school-related parameters and what do ICT leader-related variables add to this prediction?

2 | METHOD

2.1 | Participants and context

In order to promote collaborative learning activities between schools in Israel, the district ICT Ministry of Education Department initiated a regional project in 2017–2018 school year, which was aimed at promoting digital collaborative learning processes between schools. In order to reach this goal, the district ICT coordinators assisted regional coordinators in designing between school collaborative projects, which were suitable for the schools they guided. The regional coordinators held meetings with the school ICT coordinators and some of the leading teachers in order to help them design and lead a suitable collaborative activity.

According to the needs of different projects, the coordinators conducted online communication and/or were involved in face-to-face activities with other teachers in their schools or in partner organization of inter-school collaboration. In some cases, they involved parents in order to prepare and conduct project happenings or hackathons. The coordinators could choose a variety of methods, for example, creating a collaborative database, participating in online discussions and writing, joint exploration or creation of digital artefacts. Each of the activities planned by the teams aimed to create digital collaborative outcomes, such as drawings, posters, comics, presentations, mind-maps, games, quizzes. To promote peer learning and the exchange of ideas, at the end of the school year, the collaborative activities were presented at the district conference.

The study participants included 513 Israeli school *ICT coordinators* and leading teachers, 80% of them women, which is consistent with the prevalence of women in the Israeli education system, especially in elementary education. Among them, 214 (41.7%) were from Hebrew-speaking schools and 299 (58.3%), were from Arabic-speaking schools. Regarding the school level, 413 (80.5%) of the participants were elementary school teachers and 100 (18.5%) of them were middle school teachers. Participants' seniority in teaching ranged between 4 and 25 years, and seniority in teacher training ranged between 1 and 15 years. While both *ICT coordinators* and leading teachers are part of school-level leadership, they mainly continue their teaching (in contrast to regional *ICT coordinators* who are mostly teachers' trainers). Both *ICT coordinators* and leading teachers are recognized as leaders of technology-enhanced teaching by their teaching staff and principals. The main difference between the two groups is that while an *ICT coordinator* is an official position, the role of leading teachers is a more informal, voluntarily form of leadership in educational organizations.

In order to triangulate the findings reported by the educators, at the end of the collaborative initiative led by the district, an online questionnaire was randomly sent to a small sample of *students* from one of the participating cities in the project. These students studied in four different urban Hebrew-speaking schools. Of the 50 students that received the questionnaire, 35 (70%) students have chosen to participate, 20 (57%) of these students studied in elementary schools, and 15 (43%) in middle schools. The goal of the collaborative project in this city was to create a digital guide of the city that would include information, pictures, games, and videos about interesting sites in the city. These included historical, cultural, and recreational sites chosen by the students.

2.2 | Instruments and procedure

The study was conducted within the mixed-method research paradigm. At the end of the district collaborative initiative, all of the *ICT coordinators* and a small sample of *students* were asked to complete an online questionnaire.

2.3 | ICT coordinators

The coordinators' questionnaire included *multiple-choice questions* rated on a Likert scale ranging from 1 = not at all to 5 = very much (questions started with 'to what extent...') or from 1 = totally disagree to 5 = totally agree (all other multiple-choice questions), as well as open-ended questions. The items were grouped in several indexes as described below:

- *Online communication* was measured by items that evaluated the degree of digital communication. Communication within the teaching staff index included two items: 'To what extent do you conduct ongoing email communication with the school staff?' and 'To what extent do you communicate with the school staff through forums or collaborative documents?'. Similar items measured online communication between teachers and their students or between teachers and parents: 'To what extent do your teachers conduct ongoing email communication with students/parents?' and 'To what extent do your teachers communicate with students/parents through forums or collaborative documents?'
- *The coordinators' leadership experience* index included six items describing the experience of leading the design and execution of the project: 'It was important for me to participate in the online collaborative project'; 'I enjoyed designing collaborative activities'; 'Designing collaborative activities was challenging' (reversed); 'I was a full partner in shaping collaborative activities'; 'I accepted the responsibility of designing collaborative activities'; 'I played an active role in leading the collaborative project'.
- *Coordinators' professionalism* index was measured by four items in which coordinators were asked to rate their perceived level of professionalism: 'I possess wide professional and pedagogical knowledge'; 'I am a professional authority for the teachers in my school'; 'I fully collaborate with the regional and/or district *ICT coordinators*'; 'I take part in the district *ICT* initiatives'.
- Three aspects of the *PL* instrument were adapted from previous studies (Blau & Caspi, 2008; Caspi & Blau, 2008, 2011) to the context of this research:
 - *Cognitive PL* measured the coordinators' learning process and included three items: 'I learned new things from designing collaborative activities'; 'In the process of designing collaborative activities, I learned things that I can implement in other areas'; 'As a result of participating in the collaborative project, I look at things differently'.
 - *Emotional PL* included the items: 'Designing collaborative activities was a burden' (reversed) and 'collaboration with other schools was challenging' (reversed).
 - *Social PL* measured the coordinators' social learning process and included two items: 'I enjoyed interacting with the district and/or regional *ICT coordinators* during the collaborative activities' and 'I enjoyed interacting with fellow school *ICT coordinators* during the collaborative activities'.

TABLE 1 Descriptive statistics for the study indexes ($n = 513$)

| Variable | Mean (SD) | Median | Skewness (SD) | Range | Cronbach's α / r value |
|-----------------------------------------|-------------|--------|----------------|-----------|---------------------------------|
| Online communication: Teaching staff | 4.05 (0.86) | 4.00 | -0.777 (0.108) | 1.00–5.00 | $r = .462^{**}$ |
| Online communication: Teachers-parents | 2.61 (1.36) | 2.50 | 0.446 (0.108) | 1.00–5.00 | $r = .721^{**}$ |
| Online communication: Teachers-students | 3.26 (1.30) | 3.00 | -0.142 (0.108) | 1.00–5.00 | $r = .635^{**}$ |
| Coordinators' leadership experience | 3.67 (1.30) | 4.00 | -1.01 (0.108) | 1.00–5.00 | $\alpha = .976$ |
| Coordinators' professionalism | 4.67 (0.65) | 5.00 | -3.14 (0.108) | 1.00–5.00 | $\alpha = .917$ |
| Cognitive perceived learning | 2.77 (1.37) | 3.00 | -0.757 (0.108) | 1.00–5.00 | $\alpha = .953$ |
| Emotional perceived learning | 3.43 (1.26) | 4.00 | 0.366 (0.108) | 1.00–5.00 | $r = .569^{**}$ |
| Social perceived learning | 3.63 (1.31) | 4.00 | -0.922 (0.108) | 1.00–5.00 | $r = .756^{**}$ |
| Sustainability | 1.89 (0.30) | 2.00 | -2.58 (0.108) | 1.00–2.00 | — |
| Students' digital collaborative skills | 3.64 (1.34) | 4.00 | -0.927 (0.108) | 1.00–5.00 | $\alpha = .970$ |

All the significance of r is $<.001$.

- **Sustainability:** the coordinator was asked 'To what extent will the school continue digital collaboration in the next school year?'
- **Students' digital collaborative skills:** the coordinator was asked to rate the students' experience during the project, and the development of their digital interaction skills. This index included three items: 'The students benefited from collaborative activities'; 'The students collaborated willingly'; 'The activity helped develop the students' collaborative skills'.

The face validity of the scales was assessed by three specialists in the field—two educational researchers with teacher training practical experience and one educational practitioner holding an MA degree in educational technology and possessing rich experience in research on digital collaboration in education. These specialists ensured that the study concepts were consistent with their measurements. Additionally, for the PL instrument, factor analysis with Varimax rotation was conducted. Consistent with previous studies, this analysis revealed three aspects of PL: cognitive, emotional, and social. Based on the loadings, all the PL items were included in the indexes.

Table 1 presents descriptive statistics of the study indexes. We report Cronbach's alpha for the indexes based on at least three items and Pearson correlations instead of alpha for the indexes based on two items.

In order to reach a deeper understanding of the coordinators' perspective, the questionnaire also included two *open-ended questions*. The ICT coordinators were asked to provide detail regarding their experience of leading the digital collaboration project and to write general comments regarding the project they participated in. Among 513, 51 (10%) coordinators did not respond to the open-ended questions (29 from Hebrew-speaking and 22 from Arabic-speaking schools).

The answers were analyzed 'bottom-up' and categorized using a thematic analysis technique. These open-ended questions yielded 901 codes: 352 codes from Hebrew-speaking schools' coordinators and 549 from Arabic-speaking schools. The bottom-up coding was not exclusive and each statement could be attributed to more than one category.

2.4 | Students

The students' questionnaire included *multiple-choice questions* rated on a Likert scale ranging from 1 = totally disagree to 5 = totally agree, as well as open-ended questions. The multiple-choice items were grouped in the following indexes:

- The *cognitive PL* index measured student learning processes according to three items: 'The online project helped me develop the skills needed to collaborate with other students'. 'The collaborative activity was relevant to me'. 'I think that collaboration with other schools is important'.
- The *emotional PL* index included two items: 'It was interesting to collaborate with students from other schools' and 'Collaborating with students from other schools was difficult' (reversed).
- The *social PL* index included two items: 'I enjoyed the online collaboration activity' and 'I collaborated willingly with students from other schools'.
- *Students' digital collaborative skills* were measured by the item: 'I think that the project that I prepared in collaboration with other students was of high quality'.
- *Sustainability* was measured by the item: 'In your opinion, should your school continue digital collaboration in the next school year? Yes/No'. In addition, to this dichotomous variable, a preference for *diminishing the project* was measured by the Likert scale item: 'In the next year, I prefer to only collaborate with students from my school'. It was important for us not only to understand sustainability as existing or absent, but also to explore whether after the top-down project is finished, students felt it should continue as inter-school collaboration, or be diminished to a more traditional intra-school collaboration. Please note that two sustainability items were analyzed separately, since they could not be scored together (as explained, one is a dichotomous item and another is a Likert scale item).

Table 2 presents descriptive statistics of the study indexes.

In order to reach a deeper understanding of the students' perspectives, the questionnaire also included two open-ended questions. The students were asked to report: 'Please explain what is important to preserve in next year's collaboration activities' and 'Please explain what is important to improve in next year's collaboration activities'. All of the students answered the open-ended questions, which yielded 131 codes. The bottom-up coding was not exclusive and each statement could be attributed to more than one category.

To assure inter-rater reliability, 25% of all the statements written by both educators and students were analyzed by a second rater and the agreement level was high, Cohen's Kappa $\kappa = 0.87$.

3 | RESULTS

3.1 | Differences in the collaboration process as a function of culture

In order to examine the differences between the study variables as a function of culture (individualistic versus collectivistic), independent samples ttests and Cohen's d effect size were calculated to compare Hebrew-speaking schools and Arabic-speaking schools. Table 3 presents these results.

As can be seen in Table 3, there was a significant difference between the ICT coordinators' reports from Hebrew- and Arabic-speaking schools on a variety of study variables. In comparison with Arabic speaking school coordinators, Hebrew-speaking school coordinators reported higher levels of online communication between the teaching staff and parents, with a large effect size, and between teachers and students, with a small effect size. In addition, the Hebrew-speaking coordinators scored higher in the emotional aspect of PL, with a small-medium effect size. In contrast, Arabic-speaking school coordinators reported a more positive leadership experience and a higher degree of professionalism, as well as higher levels of social and cognitive aspects of PL, with small effect sizes. However, no significant differences between Hebrew-speaking and Arabic speaking coordinators were found in their reports of the students' digital collaboration skills. Finally, the Arabic-speaking coordinators reported greater willingness to continue the online collaboration project in the following school year, with a small effect size.

As described in Section 2, the questionnaire also included two open-ended questions. Table 4 presents the bottom-up analysis of the responses to these questions and a chi-square Goodness of Fit

Test of differences between Hebrew-speaking and Arabic-speaking schools.

As can be seen, most of the statements were related to the sustainability of collaboration, and the only significant difference was found in coordinators' leadership—in favour of the coordinators from Arabic-speaking schools.

3.2 | Predicting coordinators'leadership experience

In order to predict the coordinators' leadership experience, two-step regression analyses were performed separately for each cultural group. The first step included the *general school variables* not related to the collaborative project, which explained 4.4% of the variance in the level of coordinators' leadership experience in Hebrew-speaking schools, and 10.7% in Arabic-speaking schools. The second step included *coordinator-related variables* relevant to the collaborative project, which go beyond the general school variables. This step explained 89.4% of the variance, adding 85% to the prediction of coordinators' leadership experience in Hebrew-speaking schools. Among Arabic-speaking schools it explained 92.4% of the variance, adding 81.7% to the prediction (Table 5).

As can be seen, in the first step of the regression among Hebrew-speaking schools, the only marginally significant predictor found was the online communication between teachers and parents. Among Arabic-speaking schools, higher online communication with students and within the teaching staff were associated with a more positive experience of leadership among coordinators. Coordination in elementary education (in comparison with middle-school education) was associated with a more positive leadership experience. In the second regression step, a higher level of social PL among coordinators and greater digital collaboration skills among students were associated with a more positive experience of leadership among coordinators in both Hebrew-speaking and Arabic-speaking schools. Cognitive PL was only found to be a significant predictor of coordinators' leadership experience in Hebrew-speaking schools, while emotional PL only predicted leadership experience in Arabic-speaking schools. These variables, together with online communication between teachers and parents (negative predictor), explained most of the variance in the coordinators' leadership experience.

One of the themes found while analyzing the participants' responses to open-ended questions helped to shed light on the coordinators' perspectives in the professional development they experienced while leading the digital collaboration activity. Table 6 presents the analysis of coordinators' responses for sub-categories of the

TABLE 2 Descriptive statistics for the students' study indexes ($n = 35$)

| Variable | Mean (SD) | Median | Skewness (SD) | Range | Cronbach's α/r value |
|------------------------------|-------------|--------|---------------|-----------|-----------------------------|
| Cognitive perceived learning | 4.09 (0.94) | 4.33 | -2.10 (0.398) | 1.00–5.00 | $\alpha = .86$ |
| Emotional perceived learning | 3.64 (0.95) | 3.50 | 0.161 (0.398) | 2.00–5.00 | $r = .74^{***}$ |
| Social perceived learning | 4.35 (0.96) | 4.50 | -2.54 (0.398) | 1.00–5.00 | $r = .83^{***}$ |

All the significance of r is $<.001$.

TABLE 3 *t* tests comparing Hebrew-speaking and Arabic-speaking schools (*n* = 513)

| Variable | Hebrew (<i>n</i> = 214) Mean (SD) | Arabic (<i>n</i> = 299) Mean (SD) | <i>t</i> test | <i>p</i> value | Cohen's <i>d</i> |
|----------------------------------------------------------|---------------------------------------|---------------------------------------|---------------|----------------|------------------|
| Online communication: Teaching staff | 4.39 (0.80) | 3.80 (0.82) | 8.02 | .000 | 0.73 |
| Online communication: Teachers-parents | 3.22 (1.32) | 2.17 (1.20) | 9.31 | .000 | 0.84 |
| Online communication: Teachers-students | 3.45 (1.47) | 3.13 (1.15) | 2.80 | .005 | 0.24 |
| Coordinators' leading experience | 3.46 (1.53) | 3.82 (1.07) | -3.14 | .002 | -0.28 |
| Coordinators' professionalism | 4.60 (0.75) | 4.73 (0.57) | -2.21 | .027 | -0.19 |
| Cognitive perceived learning | 3.14 (1.49) | 3.63 (1.02) | -4.32 | .000 | -0.38 |
| Emotional perceived learning | 3.14 (1.58) | 2.52 (1.18) | 5.19 | .000 | 0.44 |
| Social perceived learning | 3.41 (1.55) | 3.78 (1.08) | -3.18 | .002 | -0.28 |
| Sustainability | 1.85 (0.357) | 1.93 (0.262) | -2.77 | .006 | -0.26 |
| Coordinators' estimation of students' digital literacies | 3.55 (1.57) | 3.70 (1.14) | -1.22 | .222 | -0.11 |

The significance is already presented - in the column *p* value.

The bold highlights which of the two means is larger.

TABLE 4 Frequencies of categories of the ICT coordinators' responses to open-ended questions

| Categories | Hebrew-speaking schools <i>n</i> = 185 | Arabic-speaking schools <i>n</i> = 277 | Total | Chi-square test | Representative quotes |
|-----------------------------------------------------|-------------------------------------------|-------------------------------------------|-------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coordinators' leadership | 67 33% | 138 67% | 205 | χ^2 (1, <i>N</i> = 205) = 4.57, <i>p</i> = .032 | ICT teaching and guidance is very satisfying work, and there is certainly more to change, initiate and promote |
| Students' digital collaboration skills | 7 33% | 14 67% | 21 | χ^2 (1, <i>N</i> = 21) = 0.389, <i>p</i> = .533 | Collaborative projects promote the social values of our students, develop their digital literacy and leadership skills, and improve academic competencies and higher-order thinking |
| Sustainability—continuing/expanding e-collaboration | 222 42% | 302 58% | 524 | χ^2 (1, <i>N</i> = 524) = 1.22, <i>p</i> = .269 | We intend to continue participating in digital collaborative learning next year |
| Sustainability—Reducing e-collaboration | 56 37% | 95 63% | 151 | χ^2 (1, <i>N</i> = 151) = 0.534, <i>p</i> = .465 | Collaboration is a method—not a topic. The school did not realize that it is a way of learning. You cannot bring the horse to the trough and force it to drink! |
| Total | 352 40% | 549 60% | 901 | χ^2 (1, <i>N</i> = 901) = 0.326, <i>p</i> = .568 | |

leadership experience, as well as differences between the coordinators from Hebrew- and Arabic-speaking schools.

As Table 6 shows, significantly more statements that expressed leadership experiences in general, and leading the teaching staff in particular, were attributed to the coordinators from Arabic-speaking schools compared to Hebrew-speaking schools.

3.3 | Predicting students' digital collaboration skills

In order to examine which variables predict students' digital collaboration skills, a two-step regression analysis was performed separately

for each school group. The first step included the general school variables not related to the project integration, and explained 8.9% of the variance in the students' collaboration skills in Hebrew-speaking schools, and 13.4% in Arabic-speaking schools. The second step of the regression added coordinator-related variables and explained 72.3% of the variance, adding 63.4% in the students' collaboration skills in Hebrew-speaking schools. In Arabic-speaking schools, it explained 79.2% of the variance, adding 65.8% to the prediction. Table 7 shows these results.

As Table 7 shows, in the first regression step, among the Hebrew-speaking schools, a higher level of online communication between teachers and parents was associated with a higher level of students'

TABLE 5 Predictors of ICT coordinators' leading experience

| Hebrew-speaking schools | | | | Arabic-speaking schools | | |
|--------------------------------------------------------------------|---------------------|--------|------|-------------------------|--------|------|
| Variable | β | t | p | β | t | p |
| Step 1 | | | | | | |
| Educational stage (elementary/middle school) | -.014 | -0.199 | .842 | -0.174 | -3.135 | .002 |
| Online communication: Teaching staff | .035 | 0.476 | .635 | .159 | 2.362 | .019 |
| Online communication: Teachers-parents | .156 | 1.792 | .075 | -.167 | -2.358 | .019 |
| Online communication: Teachers-students | .055 | 0.650 | .517 | .237 | 3.204 | .002 |
| F value | (4,209) = 2.401* | | | (4,294) = 8.828*** | | |
| R ² | 0.044 | | | 0.107 | | |
| Step 2 | | | | | | |
| Educational stage (elementary/middle school) | .011 | 4.33 | .666 | -.009 | -0.532 | .595 |
| Online communication: Teaching staff | -.023 | -0.793 | .429 | .022 | 1.067 | .287 |
| Online communication: Teachers-parents | .024 | 0.811 | .418 | -.036 | -1.696 | .091 |
| Online communication: Teachers-students | .012 | 0.460 | .644 | .021 | 0.941 | .348 |
| Coordinators' professionalism | .034 | 0.320 | .188 | .014 | 0.758 | .449 |
| Cognitive perceived learning | .172 | 2.999 | .003 | .064 | 1.666 | .097 |
| Emotional perceived learning | .002 | 0.071 | .944 | .044 | 2.108 | .036 |
| Social perceived learning | .601 | 9.619 | .000 | .654 | 16.019 | .000 |
| Coordinators' estimation of students' digital collaboration skills | .202 | 4.947 | .000 | .237 | 7.278 | .000 |
| F value | (9,204) = 191.83*** | | | (9,289) = 392.10*** | | |
| R ² | 0.894 | | | 0.924 | | |

Bold values are already the significance, they are presented in columns "p".

For ***, all p's<.001, for *, p=.023.

digital collaboration skills. As for Arabic-speaking schools, a higher level of online communication within the teaching staff and between teachers and students were associated with a higher level of digital collaboration skills among students. In contrast, a higher level of teacher-parent e-communication and coordination in elementary education (compared to middle-school education) were associated with a lower level of digital collaboration skills among students. In the second regression step, the coordinators' leadership experience, in both Hebrew- and Arabic-speaking schools, was a powerful positive predictor of students' digital collaboration skills. These variables, together with social PL—in Hebrew-speaking schools, and cognitive PL and teacher-student e-communication—in Arabic-speaking schools, explained most of the variance in students' digital collaboration skills.

Responses to the open-ended questions generated relatively few codes ($n = 21$) which can be attributed to students' skill—14 of them were reported by the ICT coordinators from Arabic-speaking schools and 7 of them from Hebrew-speaking schools (see Table 4).

The data collected from the ICT coordinators was cross-checked with the students' data. In order to examine which variables predict the students' digital collaboration skills according to their own evaluation, a Pearson correlation test was first conducted to reveal the relationship between students' digital collaboration skills, PL, educational stage, and sustainability according to the students' perspective. The correlations are presented in Table 8.

Results of the Pearson correlation indicated that there were high positive associations between students' digital collaboration skills and the cognitive and social aspects of PL.

Based on the correlation results, a multiple regression analysis was performed with the three aspects of PL as predictors of students' digital collaboration skills. The predictors explained 64.6% of the variance in students' digital collaboration skills, $F(3,31) = 18.83$, $p = .000$. The results are presented in Table 9.

As Table 9 shows, higher social PL among students predicted a higher level of students' digital collaboration skills.

Table 10 presents the analysis of the students' responses to open-ended questions categorized as aspects of perceived learning.

The findings showed that the students perceived the online project as contributing, relevant, and important. A high percentage of cognitive PL statements referred to active learning by doing. The percentage of negative emotional and social PL statements was very low compared to the percentage of positive statements.

3.4 | Predicting the sustainability of collaboration

The majority of ICT coordinators (89.5%) reported that they were interested in continuing the collaborative project in the following school year. To examine which variables predict the sustainability of

TABLE 6 Frequencies of sub-categories of coordinators' leadership experience

| Categories | Hebrew-speaking schools n = 185 | Arabic-speaking schools n = 277 | Total | Chi-square test | Representative quotes |
|--------------------------------------------------------------------------|------------------------------------|------------------------------------|-------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coordinators' Leadership and personal development | 24 33% | 25 67% | 49 | $\chi^2(1, N = 49) = 1.65, p = .199.$ | As an ICT coordinator, at the end of the year, I present the collaborative project to all of the school staff. This gives the teachers an opportunity to apply collaboration to their subject-matters |
| Coordinators' leadership experience within the teaching staff | 12 33% | 46 67% | 58 | $\chi^2(1, N = 58) = 9.01, p = .003$ | The integration of a collaborative culture not only among students, but also among the teaching staff who promoted collaborative design and sharing of students' assessments and digital tasks |
| Coordinators' leadership experience with students | 6 42% | 13 58% | 19 | $\chi^2(1, N = 19) = 0.56, p = .454$ | My role as a coordinator is to mentor students and to encourage them to become leaders |
| Coordinators' leadership experience with parents and community | 2 32% | 6 68% | 8 | $\chi^2(1, N = 8) = 0.75, p = .386$ | It is important that collaboration is conducted on topics that could be meaningful to parents and the wider community as well |
| Coordinators' leadership experience and school culture | 11 29% | 28 71% | 39 | $\chi^2(1, N = 39) = 2.26, p = .133$ | Collaboration has become a very important part of school life—the teaching staff cooperates willingly. It is an integral part of our curricula |
| Coordinators' leadership experience-guidance as a continuous development | 12 37% | 20 63% | 32 | $\chi^2(1, N = 32) = .006, p = .809$ | The integration of collaboration in the school will be accompanied by guidance for the ICT coordinators and will include the design of the school-wide collaborative activities |
| Total | 67 33% | 138 67% | 205 | $\chi^2(1, N = 205) = 4.57, p = .032$ | |

The significance is already presented - there is a *p* value in the column Chi-square test.

In case of significant difference, the bold highlights which of the two frequencies is larger.

collaboration, a two-step regression analysis was performed separately for each cultural group. The first step included school variables, and explained 7.3% of the variance in the sustainability of collaboration in Hebrew-speaking schools, and 2.4% in Arabic-speaking schools. The second step included coordinator-related variables, which among Hebrew-speaking schools explained 20.7% of the variance in collaboration sustainability, adding 13.4% to the prediction, and among Arabic-speaking schools predicted 12.6% of the variance, adding 10.2% to the prediction. The regression results are presented in Table 11.

As can be seen, in the first regression step, among both Hebrew-speaking and Arabic-speaking schools, educational stage (elementary/middle school) was found to negatively and significantly (marginally significant in Arabic-speaking schools) predict sustainability, indicating that sustainability is higher in elementary schools. In the second regression step, in both types of schools, coordinators' emotional PL negatively predicted sustainability. The educational stage only remained a significant negative predictor of collaboration sustainability in Hebrew-speaking schools. In Arabic-speaking schools, coordinators'

professionalism and cognitive PL were the only variables found to positively and significantly predict collaboration sustainability.

In order to shed further light on the sustainability intentions of the digital collaboration projects according to the ICT coordinators' perspectives, the participants were asked to describe their experience during the project. Their answers to the open-ended questions raised sustainability issues such as willingness to continue the project, its relationship with the school culture, and expansion of the collaboration to other classes or subject-matters within their institution or with other schools. However, it also revealed that some participants express the wish to reduce collaborative activities in the future. Table 12 presents the bottom-up analysis of the coordinators' responses regarding sustainability issues.

Despite the difficulties, the overload, the outdated equipment and lack of adequate training, most of the participants were interested in continuing and even expanding the experience of collaborative learning and its integration in the school culture. However, a chi-square Goodness of Fit Test shows that Arabic-speaking schools'

TABLE 7 Predictors of students' digital collaboration skills according to the coordinators' perspective

| Hebrew-speaking schools | | | | Arabic-speaking schools | | |
|----------------------------------------------|--------------------|--------|---------|-------------------------|--------|---------|
| Variable | β | t | p value | β | t | p value |
| Step 1 | | | | | | |
| Educational stage (elementary/middle school) | -.072 | -1.014 | .312 | -.172 | -3.151 | .002 |
| Online communication: Teaching staff | .041 | 0.562 | .570 | .136 | 2.055 | .041 |
| Online communication: Teachers-parents | .183 | 2.150 | .033 | -.166 | -2.393 | .017 |
| Online communication: Teachers-students | .122 | 1.470 | .143 | .311 | 4.267 | .000 |
| F value | (4,209) = 5.108** | | | (4,294) = 11.392*** | | |
| R ² | 0.089 | | | 0.134 | | |
| Step 2 | | | | | | |
| Educational stage (elementary/middle school) | -.062 | -1.563 | .120 | -.027 | -.977 | .329 |
| Online communication: Teaching staff | .034 | 0.792 | .429 | .014 | 0.401 | .689 |
| Online communication: Teachers-parents | .068 | 1.426 | .155 | -.044 | -1.226 | .221 |
| Online communication: Teachers-students | .069 | 1.470 | .143 | .119 | 3.216 | .001 |
| Coordinators' leadership experience | .530 | 4.947 | .000 | .707 | 7.887 | .000 |
| Coordinators' professionalism | -.037 | -0.885 | .377 | -.020 | -.651 | .515 |
| Cognitive perceived learning | -.023 | -0.238 | .812 | .180 | 2.874 | .004 |
| Emotional perceived learning | .031 | 0.607 | .545 | -.009 | -.249 | .803 |
| Social perceived learning | .303 | 2.525 | .012 | .053 | 0.572 | .567 |
| F value | (9,204) = 59.12*** | | | (9,289) = 122.37*** | | |
| R ² | 0.723 | | | 0.792 | | |

Bold values are already the significance, they are presented in columns "p".

For ***, all p's<.001, for **, p=.012.

TABLE 8 Pearson correlations between students' digital collaboration skills, perceived learning, educational stage, and sustainability variables (n = 35)

| | Cognitive perceived learning | Emotional perceived learning | Social perceived learning | Educational stage | Sustainability-reduce | Sustainability-continue |
|----------------------------------------|------------------------------|------------------------------|---------------------------|-------------------|-----------------------|-------------------------|
| Students' digital collaboration skills | 0.659*** | 0.256 | 0.799*** | 0.144 | 0.144 | -0.043 |

***p < .001.

TABLE 9 Predictors of students' digital collaboration skills (n = 35)

| Variable | B | β | t | p value |
|------------------------------|--------|---------|--------|---------|
| Cognitive perceived learning | -0.187 | -.179 | -0.803 | .428 |
| Emotional perceived learning | 0.016 | .016 | 0.140 | .889 |
| Social perceived learning | 0.969 | .951 | 4.180 | .000 |

coordinators reported significantly greater willingness to reduce the scope of the project as a result of technical difficulties. On the other hand, Hebrew-speaking schools' coordinators reported significantly more willingness to reduce the scope of the project as a result of insufficient pedagogical guidance/training and to expand e-collaboration with external leadership.

The students referred to the sustainability issues in both multiple-choice and open-ended questions. Impressively, students' answer to the multiple-choice question revealed that 94% of them are interested in continuing the project in the following school year. Similarly, most (91.4%) of the students' responses to the open-ended questions show willingness to sustain collaboration (Table 13). A small number of

TABLE 10 Frequencies of sub-categories of students' perceived learning

| Categories | Total | Representative quotes |
|--------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cognitive PL—skills development | 5 | Now I know how to prepare games that are both fun and teach about our city |
| Cognitive PL—(I knew, learned, implemented) | 21 | I discovered a lot of new places in the city with which I was unfamiliar before. It helped me to learn many new things - I really become familiar with our city |
| Cognitive PL—learning through designing outcomes | 9 | We created artefacts and games, we distributed information, and we produced videos about the city ... What was good was that children, rather than adults, prepared them |
| Cognitive PL—Relevance to the learner's world | 19 | It is important to learn more things that I did not know about our city |
| Emotional PL (positive) | 13 | It's really fun to show people the outcomes you designed ...It was a wonderful experience for me! |
| Emotional PL (negative)—challenges, difficulties | 2 | The work was delayed several times because it had to be corrected |
| Social PL—reference to collaboration within the school | 9 | The project added to the class cohesiveness... |
| Social PL—reference to collaboration between schools | 4 | The work on the project reinforces cooperation between schools and enables children to make new friends |
| Total | 82 | |

TABLE 11 Predictors of collaboration sustainability

| Hebrew-speaking schools | | | | Arabic-speaking schools | | |
|----------------------------------------------|---------------------|--------|---------|-------------------------|----------------------------|---------|
| Variable | β | t | p value | β | t | p value |
| Step 1 | | | | | | |
| Educational stage (elementary/middle school) | -.216 | -3.028 | .003 | -.108 | -1.858 | .064 |
| Online communication: Teaching staff | .029 | 0.392 | .695 | -.092 | -1.305 | .193 |
| Online communication: Teachers-parents | .122 | 1.426 | .155 | .109 | 1.481 | .140 |
| Online communication: Teachers-students | -.031 | -0.372 | .710 | .014 | .183 | .855 |
| F value | (4,209) = 4.136** | | | | (4,294) = 1.807 (p = .127) | |
| R ² | 0.073 | | | | 0.024 | |
| Step 2 | | | | | | |
| Educational stage (elementary/middle school) | -.216 | -3.189 | .002 | -.064 | -1.132 | .259 |
| Online communication: Teaching staff | -.058 | -0.783 | .434 | -.187 | -2.621 | .009 |
| Online communication: Teachers-parents | .066 | .811 | .418 | .157 | 2.152 | .032 |
| Online communication: Teachers-students | -.009 | -0.115 | .909 | -.029 | -.380 | .704 |
| Coordinators' leadership experience | .174 | 0.907 | .366 | .021 | 0.106 | .916 |
| Coordinators' professionalism | .114 | 1.603 | .110 | .174 | 2.769 | .006 |
| Cognitive perceived learning | .216 | 1.341 | .182 | .283 | 2.169 | .031 |
| Emotional perceived learning | -.296 | -3.389 | .001 | -.139 | -1.956 | .051 |
| Social perceived learning | .026 | 0.127 | .899 | .064 | 0.333 | .740 |
| Students' digital collaboration skills | .061 | 0.516 | .606 | -.069 | -0.573 | .567 |
| F value | (10,203) = 5.309*** | | | | (10,288) = 4.148*** | |
| R ² | 0.207 | | | | 0.126 | |

TABLE 12 Frequencies of categories related to collaboration sustainability

| Categories | Hebrew-speaking schools n = 185 | | Arabic-speaking schools n = 277 | | Total | Chi-square test | Representative quotes |
|------------------------------------------------------------------|------------------------------------|-----|------------------------------------|-----|-------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Continue e-collaboration | 134 | 43% | 176 | 57% | 31 | $\chi^2 (1, N = 310) = 1.34$, $p = .246$ | We will continue the project in the next year based on the lessons learned this year |
| Expand e-collaboration to other subject-matters | 28 | 35% | 51 | 65% | 79 | $\chi^2 (1, N = 79) = 0.68$, $p = .408$ | We would like to increase using shared documents to perform tasks and expand collaboration between students in various subject-matters |
| Expand e-collaboration within the school | 21 | 36% | 37 | 64% | 58 | $\chi^2 (1, N = 58) = 0.35$, $p = .555$ | The school is interested in promoting collaborative learning, but it is essential to collaborate within the school. This is more suitable to our students |
| Expand e-collaboration with other schools | 29 | 48% | 33 | 53% | 62 | $\chi^2 (1, N = 62) = 1.19$, $p = .276$ | Our school intends to find other schools for partnership in collaboration on core subject-matters |
| Expand e-collaboration with external leading | 10 | 66% | 5 | 34% | 15 | $\chi^2 (1, N = 15) = 4.44$, $p = .035$ | We will expand our activities with schools-partners, in accordance with the instructions given by X [the organization which leads the partnership] |
| Reduce e-collaboration | 15 | 39% | 24 | 61% | 39 | $\chi^2 (1, N = 39) = 0.04$, $p = .845$ | We will continue the project in the same format, but with a limited scope |
| Reduce e-collaboration because of technical difficulties | 20 | 29% | 50 | 71% | 70 | $\chi^2 (1, N = 70) = 3.81$, $p = .051$ | Computers in the classrooms are old, slow, and some of them no longer work, which inhibits technology-enhanced learning |
| Reduce e-collaboration because of workload | 8 | 34% | 16 | 66% | 24 | $\chi^2 (1, N = 24) = .044$, $p = .505$ | This year we felt a heavy workload in most of the subject-matters. Therefore, only a few of the goals of the collaborative project were met. Next year we will limit the project scope |
| Reduce e-collaboration because of insufficient guidance/training | 13 | 72% | 5 | 28% | 18 | $\chi^2 (1, N = 18) = 7.79$, $p = .005$ | It is difficult to guide a large teaching staff and meet various demands of collaborative activities without devoting the ICT coordinator's teaching hours to teacher support |
| Total | 278 | 41% | 397 | 59% | 675 | $\chi^2 (1, N = 675) = 0.395$, $p = .530$ | |

The significance is already presented - there is a p value in the column Chi-square test.

In case of significant difference, the bold highlights which of the two frequencies is larger.

statements revealed the desire to stop the project because of the need for considerable time investment.

4 | DISCUSSION

This study explored the impact of online collaborative learning as a function of culture in 513 elementary and middle schools in Israel.

Some of these were Hebrew-speaking schools that are characterized by a more individualistic culture, while others were Arabic-speaking schools that are characterized by a more collectivist culture (Ben-Zion et al., 2007). In addition, the study examined which school-related variables predicted ICT coordinators' experience of leading collaborative projects. Lastly, this study explored how the ICT coordinators' leadership experience, their professionalism, as well as cognitive, emotional, and social aspects of PL when leading the collaboration, added to the

TABLE 13 Frequencies of categories of students' sustainability intentions

| Categories | Total | Representative quotes |
|----------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sustainability—reluctance to continue | 3 | This project requires a lot of time and a lot of work |
| Sustainability—Willingness to continue | 32 | In my opinion, it is important to continue this project because you learn not from books, but through fun activities that you will not forget for a long time |
| Total | 35 | |

prediction of students' digital collaboration skills and the sustainability of the e-collaboration in schools. Data gathered from ICT coordinators were triangulated with data from a sample of students.

The findings of the first research question regarding the differences between the schools as a function of culture revealed that schools with a more individualistic learning culture maintained higher levels of online communication within the teaching staff and between teachers, students, and parents, compared to more collectivistic schools. These findings reflect the intensive growth of digital communication and pedagogical data exchange through online or mobile platforms among teaching staff, students, and parents in order to promote educational dialog in schools characterized by individualistic learning culture demonstrated in previous studies (Blau & Hameiri, 2012, 2017; Blau, Peled, & Nussan, 2016). Since online communication is more impersonal compared to face-to-face interactions (e.g., Barak & Suler, 2008), schools characterized by a collectivistic learning culture may highly value non-mediated communication and tend to conduct more of their educational dialogue in offline settings.

The ICT coordinators in more collectivistic schools reported a significantly higher level of leadership experience, perception of professionalism, cognitive and social PL during the collaborative projects, and expressed greater willingness to continue collaboration in the next school year. Arabic-speaking schools in Israel push beginning teachers to fit into the traditional organizational culture that struggles to adopt changes in general, and technological innovations in particular (Toren & Iliyan, 2008). The Arabic-speaking school coordinators were required to design learning activities during the project, in contrast with their traditional approach that encourages the use of existing learning materials (McKenney, Kali, Markauskaite, & Voogt, 2015). This, in turn, increased their perception as professionals and competent designers of teaching-learning processes (Kirschner, 2015). The quantitative findings were consistent with qualitative coding showing higher percentages of leadership and sustainability statements among ICT coordinators in these schools. It seems that collaborative activities are integrated more naturally in schools with collectivistic culture. However, the differences found in our study need to be interpreted with caution, since they might be also affected by additional variables, which were not explored in this research, for example, quality of teachers or commonly used teaching methods.

Despite the variety of differences mentioned above, our results showed similar levels of students' digital collaboration skills in both types of schools. It is reasonable to assume that, since collaboration was a top-down district initiative, students in both types of schools similarly benefited from being exposed to pedagogically well-designed activities. However, the results regarding students' digital collaboration should be interpreted with caution, since the comparison is based on the reports of ICT coordinators rather than the students themselves (Note that all of the participating students in this study were from Hebrew-speaking schools, so that the comparison between students' reports as a function of culture was not possible).

Regarding the second research question, exploring the predictors of coordinators' leadership experience, the findings revealed that students' digital collaboration skills and coordinators' cognitive and social PL when leading the projects were significant positive predictors in both types of schools. In Arabic-speaking schools, online communication between teachers and parents negatively predicted coordinators' leadership experience. Together with the RQ1 findings, our results suggest that in more collectivistic schools, teachers prefer personal face-to-face or phone interactions with parents rather than written e-communication. This explanation is consistent with qualitative data showing partnership with school communities in these type of schools. Namely, the ICT coordinators from the Arabic-speaking schools referred twice as much as their Hebrew-speaking colleagues to the experience of leading the project with parents (Table 5). Our findings are consistent with previous studies that attribute community interactions to the values of cultural collectivism, and indicate the importance of the environment and its impact on the individual (Ben-Zion et al., 2007).

The third research question aimed to predict the digital collaboration skills of students. Online collaboration has the potential to develop students' digital literacy skills, as well as affect a variety of academic, psychological, and social outcomes (Blau & Caspi, 2009; Barak, 2007; Porat, Blau, & Barak, 2018), and thus, ensure students' current and future efficient functioning in digital environments (Eshet, 2012). In our study, coordinators' leadership experience was found to be a powerful predictor of students' digital collaboration skills in both types of schools. Accordingly, the qualitative data showed prevalence of leadership codes—205 (22.8%) out of 901 statements reflected the experience of leading the collaboration. The ICT coordinators stated that they attach great importance to the development of students' digital literacy, and that e-collaboration contributes to the development of these skills. Our findings are consistent with previous studies which have demonstrated that teacher' abilities, attitudes, and beliefs affect the quality and efficiency of ICT integration in education systems (Blau & Peled, 2012; Shamir-Inbal & Blau, 2017; Rodríguez-Triana et al., 2015).

Alongside coordinators' leadership experience, the social aspect of PL in Hebrew-speaking schools, as well as cognitive PL and online communication between teachers and students in Arabic-speaking schools predicted students' digital collaboration skills. It seems that in more individualistic learning cultures, students need more social interactions in order to improve their skills. The interactions between the

teacher and the learners are crucial in motivating students' efforts to learn in digital environments and in improving student outcomes (Cobb, 2009; Sung & Mayer, 2012). Previous studies have emphasized that besides the knowledge acquisition, CSCL contributes to interpersonal communication and interaction, which are the main drives of the collaborative learning process (Persico et al., 2010; Rodríguez-Triana et al., 2015; Weiser, Blau, & Eshet-Alkalai, 2018). Online collaborative learning is a fundamentally socio-cultural phenomenon, which can be influenced by cultural differences (Anderson, 2017). However, previous studies did not compare digital collaboration as a function of culture. Our findings suggest that in more collectivistic cultures the social component is already salient, while cognitive factors—the coordinators' sense that new knowledge is acquired and that new understanding is developed—become more important for the students.

Finally, the fourth research question was regarding the prediction of the sustainability of digital collaboration and willingness to continue the project in the next school year. The prediction was medium-low—20.7% and 12.6% of variance explained for Hebrew- and Arabic-speaking schools respectively, most of which was explained by coordinator-related variables. Contrary to what might have been expected, coordinators' leading experience did not predict collaboration sustainability. Our qualitative data (Table 3) showed not only a very high number of statements which refer to sustaining and expanding collaboration ($n = 524$), but also a substantial number of statements regarding the wish to reduce the scope of collaboration in the next school year ($n = 151$). Moreover, the intention to expand or reduce collaboration was explained by a variety of reasons related to the experience of leading the project, such as technology, people, and organizational issues (see Table 8). This suggests complexity in sustainability decision-making, which can explain the difficulty found in predicting the variance in this variable as a function of coordinators' leadership experience.

In Arabic-speaking schools, online communication with parents, the coordinators' professionalism, as well as cognitive PL, were positive predictors of sustainability. As mentioned above, teacher-parent e-communication negatively predicted coordinators' leadership experience; however, it seemed to be beneficial in terms of the sustainability of collaboration. Regarding other predictors, it is reasonable that if ICT coordinators feel that through the collaboration they construct new knowledge (cognitive PL) and develop their professional abilities, they are inclined to continue leading this project.

The emotional aspect of PL was found to be a negative predictor of sustainability in both Hebrew- and Arabic-speaking schools. It seems that coordinators perceived digital collaboration as demanding a variety of resources. These perceptions predict coordinators' intention not to continue the collaboration in the following school year. This result could be explained by the qualitative data. The ICT coordinators reported many difficulties due to inadequate equipment, teachers' workload, and a lack of appropriate training and support (Table 8), which may affect their emotional PL when leading digital collaboration. This explanation is consistent with previous findings (Avidov-Ungar & Shamir-Inbal, 2017; Alonso & Gewerc, 2016).

5 | CONCLUSION, LIMITATIONS, AND EDUCATIONAL IMPLICATIONS

Our study was conducted in Israel, where the Hebrew-speaking population is more culturally individualistic, whereas the Arabic-speaking minority groups are more collectivistic (Ben-Zion et al., 2007). We found that these differences affected collaborative learning processes. Hebrew-speaking schools maintained higher levels of online communication within teaching staff, students and parents. Yet, compared to Hebrew-speaking schools, ICT coordinators from Arabic-speaking schools reported more positive leadership experiences, a higher level of professionalism, and greater willingness to continue digital collaboration in the next schoolyear.

Previous studies investigated PL in the context of learning a new topic from an expert/learning materials or developing skills in technology-enhanced environment (Blau & Caspi, 2008; Blau et al., 2020; Barzilai & Blau, 2014; Caspi & Blau, 2008, 2011). This study adds to the research literature by exploring different aspects of PL in the retrospective evaluation of *learning by leading others*. The results are generalizable to other educational contexts involving top-down initiatives in general, and promoting collaboration initiatives in particular. For instance, school coordinators in this study are agents of change within their organizations, while district and regional coordinators are out-of-school leaders who are in contact with the educational policy-makers on the one hand and with schools on the otherhand.

An examination of collaboration sustainability raised interesting findings. Although the open-ended answers contained many statements relating to the continuation and expansion of collaboration in the following year, in the regression analysis, most of the study variables were not significant predictors of sustainability, included coordinators' leading experience among both types of schools. On the other hand, the emotional aspect of PL was a negative predictor of sustainability in both types of schools. According to the qualitative data, the ICT coordinators reported a desire to reduce collaboration because of workload, technical problems, and appropriate training. Moreover, the participants claimed that collaboration between schools is more complicated than collaboration within schools, and a small number of schools ($N = 15$; 02.2%) even shared plans that an external leader will assist them in order to continue this demanding project. Instead, the hope of the district ICT department was (personal communication) that after the initial year of a top-down well-organized intervention with appropriate resources, schools would understand the benefits of inter-school collaboration and would sustain it with internal resources. Our findings suggest that, although the collaboration was successful for both ICT leaders and students, the process was difficult and complex. Thus, at the end of the initiative, at least some of the schools openly declared that they did not plan on realizing the hope of the district ICT department to sustain the collaboration on theirown.

However, our research was conducted only 1 year following the collaboration integration and it is important to replicate these findings at more mature stages of the project. For instance, Shamir-Inbal and Blau (2017) found that after the third year of ICT integration, schools reported

wider collaborative learning within and between schools. From the methodological point of view, the validity of the quantitative instruments was a face validity, which is considered as a weak form of validity. An additional limitation of this study is that students' digital collaboration skills were measured as perceived skills and only through one item. Future studies may measure students' actual collaborative skills. Moreover, although the ICT coordinators' data was triangulated with data from students studying in elementary and middle schools, the student sample size was small and did not include Arabic-speaking students (20% of the country's population). This limitation prevented the possibility of comparison between Hebrew-speaking and Arabic-speaking students, as was conducted among coordinators. Future studies should explore digital collaboration in larger and more culturally diverse samples of students.

We suggest that educational policy-makers and designers of professional development programs provide sufficient training and longitudinal support for teachers in top-down initiatives, gradually diminishing their assistance. Importantly, support needs to be provided with reference to cultural differences and to the difficulties documented in this study.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions.

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