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Teachers’ practices during Emergency Remote Teaching: an investigation of the needs for support and the role of Professional Learning Communities

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Abstract: Emergency Remote Teaching (ERT) was implemented during COVID-19 crisis lockdowns. New challenges arose and teachers sought support. Professional Learning Communities (PLCs), where teachers from similar backgrounds meet for learning and discussions, provided one channel of support. The study aimed to better understand PLCs’ role in challenging times. Therefore, we asked: 1. What challenges did teachers face, in addition to pedagogical ones, during ERT? 2. How did the various members of the PLC perceive support as shown by their descriptions of PLC activities? 3. In what ways did the ERT experience shape the teachers’ perceptions of mutual assistance? The research setting was a PLC network for chemistry teachers that met since 2018 face-to-face or via Zoom. PLCs were found important in facing both professional and emotional challenges. Discussions, sharing of teaching materials, and real-time support addressed professional challenges. Having colleagues who faced similar challenges provided support and eased communication. Thus, PLC membership helped teachers face daily challenges and improved their well-being. PLCs are therefore recommended for routine and future hardships. In practice, PLC leaders can use the results to improve teacher relationships. Conclusions add to understanding teacher collaboration in PLCs formed in diverse contexts.

Keywords: Professional Learning Communities; COVID-19; professional development; chemistry teachers

1 Introduction

The challenges chemistry teachers face in the last years include expectations to enhance students’ learning by adapting their teaching practices to current scientific, technological, and pedagogical reforms as well as to social and cultural changes (Avargil et al., 2017; Dori et al., 2023; McComb & Eather, 2017; Orland-Barak, 2020; Shemwell et al., 2015; Shwartz et al., 2016). Recently, the most significant adjustment made in teaching has been the use of Emergency Remote Teaching (ERT) while periods of lockdown were imposed during the COVID-19 Crisis, since the beginning of 2020 (Erduran & Akış, 2023; Hodges et al., 2021; Shauly et al., 2023).

It is widely accepted that teachers need support in facing new challenges (Avargil et al., 2013). One channel of providing support is through professional learning communities (PLCs) where teachers with a common background meet regularly for discussions and collective learning. In addition to sharing knowledge and classroom experiences, this platform provides educators with educational views and practices to improve students’ learning (Orland-Barak, 2020). Relationships among PLC members and the encouragement of mutual assistance distinguish PLCs from other professional development (PD) programs (e.g., Aslam et al., 2018; Van Meeuwen et al., 2020;
PLCs originated in the field of education, as groups of teachers within schools working together to promote student learning (Dufour, 2004; Dufour et al., 1998; Hord, 1997, 2009; Stoll et al., 2006). Stoll et al. (2006) described five features characterizing PLCs: shared values and vision, collective responsibility, reflective professional inquiry, collaboration, and promoting group and individual learning. PLCs name and its main characteristics are related to teachers’ professional knowledge. This study used the TPACK model (Mishra & Koehler, 2008) to examine teachers’ professional knowledge. This model defines three areas of knowledge, content, pedagogy, and technology, as well as their interactions and overlap. We chose this model since it addressed technology and pedagogy integration, which was critical during ERT. Researchers have studied teachers’ needs after adapting to ERT using the TPACK model (Cavanaugh & DeWeese, 2020; Rap et al., 2020) and found they were tied to Technological Knowledge (TK), and Technological Pedagogical Knowledge (TPK). A survey of teachers of one subject matter, chemistry, also revealed TPACK needs (Rap et al., 2020). TPACK studies comparing teachers’ TPACK before COVID-19 with their work in ERT mode found that teachers with prior knowledge transitioned to teaching online more easily (Manokore & Kunzt, 2022; van der Spoel & Noroozi, 2020) and reported including more digital activities (König et al., 2020).

Later, PLCs were formed using these concepts to professionally develop STEM teachers, grouping teachers from different schools who teach the same subject (e.g., Hamos et al., 2009; Hofstein et al., 2003). To distribute knowledge and practices among teachers of the same subject, the “Fan Model”, an interconnected PLC network was developed (Eylon et al., 2020; Levy et al., 2020). The “Fan Model” is the setting of the PLCs’ network explored in this study.

Study findings in Israel suggest that PLCs, grouping teachers of the same subject matter, resulted in the application of learner-centered practices, professional connections enabling consultation and sharing experiences, and reduced feelings of isolation among teachers (Eylon et al., 2020; Levy et al., 2020; Shauly et al., 2023; Waldman, 2020; Waldman & Blonder, 2020). Studies from other countries reported similar results. For example, a study of PLCs in an urban school district in the US found that teachers felt comfortable sharing their knowledge freely, bridging gaps in their knowledge, and helping others (Richmond & Manokore, 2010). Another study described the mentorship of novice teachers for urban schools in PLCs. These groups focused on professional issues, but educators also discussed workplace challenges (Richmond et al., 2017). Vossen et al. (2020) studied teachers in Holland who participated in PLCs to create educational materials for a course on “research and design.” These materials were developed, implemented, and reflected upon in the community. Conclusions indicated the importance of collaboration.

During the COVID-19 lockdowns, teachers sought support to cope with social changes (Dori et al., 2023; Hodges et al., 2021; Trust & Whalen, 2020). In contrast to other forms of online or remote teaching, ERT is implemented immediately (Bozkurt & Sharma, 2020; Hodges et al., 2021). Teachers’ experiences in ERT mode were primarily explored through surveys (Bond, 2020; Stewart, 2021). Teachers faced high workloads, time constraints, a lack of understanding of technological tools, and poor support (DeCoito & Estateyeh, 2022; Trust & Whalen, 2020). Researchers Kim and Asbury (2020) interviewed STEM teachers during lockdowns. Teachers’ relationships with colleagues were an important support system according to their analysis. A study by Kraft et al. (2021) described the importance of school support and facilitating teachers’ work from home during this period.

Since PLCs provide support to members in routine times, the purpose of this study was to better understand the community’s role in these challenging times. In a related study, the pedagogical challenges of chemistry teachers during ERT were discussed (Shauly et al., 2023). Teachers’ feedback revealed challenges related to pedagogical aspects of teaching, with the assessment of learning rated as the most challenging. Challenges about assessment and teachers assessment knowledge have been reported before the COVID-19 Crisis (Avargil et al., 2012; Dori & Avargil, 2014a, 2014b; Peretz et al., 2023), during ERT this challenge became more pressing.

Teachers’ sources of support when facing technological challenges were also examined. Responses showed that PLC members sought support from chemistry teacher groups (Shauly et al., 2023). Pedagogy, assessment, and class management are only some of the daily challenges teachers face due to the wide range of their work.
Therefore, this study centers on other aspects of teachers’ work, namely their need for know-how and support in dealing with the application of ERT.

Thus, we asked the following research questions.
1. What challenges did teachers face in addition to pedagogical ones during ERT?
2. How did the various members of the PLC perceive support as shown by their descriptions of PLC activities?
3. In what ways did the ERT experience shape the teachers’ perceptions of mutual assistance?

2 Methodology

In this mixed methods study, qualitative and quantitative data collection were carried out separately and analyzed together to provide an in-depth interpretation of the data (Creswell et al., 2003).

2.1 Research setting

This research was conducted in the setting of a PLC network in Israel that seeks to support the development of chemistry teachers. This PLC network includes a “Leading Teacher Community” (LTC) which includes senior teachers as the basis of the network. LTC members lead “Chemistry Teacher Communities” (CTC) close to their homes, as described by the “Fan Model” (Eylon et al., 2020; Levy et al., 2020). These communities have met continuously since 2018 face-to-face or by Zoom.

2.2 Research participants

The study included two groups of participants named Group A and Group B, based on the data collected from participants. Group A included 28 teachers who were interviewed and/or contributed written reflections, they were members of the PLCs, or non-members. Group B included 122 chemistry teachers from Israel who answered a questionnaire, some were PLCs members and other non-members, see Figure 1 and “research tools” section ahead.

The participants in Group A came from two PLCs involved in this study. The Northern Israel LTC included members with more than seven years of experience from various factions of Israeli society. They led PLCs or took on other guiding responsibilities. Three coordinators, who are experienced chemistry teachers who also work in academia or as teacher supervisors in the Ministry of Education, served as leaders of Northern Israel’s LTC. The second PLC was a CTC with members whose teaching experience ranged from three to 31 years. They joined a PLC close to their homes.

Participants in Group B included 122 Israeli chemistry teachers who responded to an online questionnaire. Most respondents (67.2%) belonged to PLCs in Israel, and some of them belonged to Group A. The rest of the respondents were chemistry teachers who were not PLC members. The responding teachers came from all factions of Israeli society. Teachers’ experience was in a range between two to over 40 years of experience. Since data were collected anonymously, members of group B were only identified by their PLC involvement, i.e., LTC, CTC, or non-member. There is an overlap between Group A and Group B because some of the interviewees answered the questionnaire.

Figure 1: Grouping of research participants.
Table 1: Factors concerning possible causes for stress during ERT.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Exemplary item</th>
<th>Cronbach’s α value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching materials and activities (A)</td>
<td>The work required to update teaching materials</td>
<td>0.871</td>
</tr>
<tr>
<td>Teachers’ workplace (B)</td>
<td>The need to cover the topics according to schedules planned in routine</td>
<td>0.903</td>
</tr>
<tr>
<td>Support (C)</td>
<td>Loneliness due to social distancing from colleagues</td>
<td>0.875</td>
</tr>
<tr>
<td>School environment and resources (D)</td>
<td>Unclear information on ERT directions and schedules.</td>
<td>0.876</td>
</tr>
</tbody>
</table>

2.3 Research tools

Three research tools were used: interviews, teacher reflections, and a questionnaire.

Seven semi-structured interviews were conducted: one with a LTC coordinator, one with a member of the LTC, three with CTC teachers, and two with teachers not in PLCs. Interviewees were selected based on the availability and diversity of communities. Teachers were asked about the challenges they faced and how they overcame them during ERT. We also asked PLC members about community support and their views of the community following the ERT experience. We planned the questions, but allowed flexibility and personalization (Barriball & While, 1994). All interviews were audio-recorded, transcribed, and qualitatively analyzed.

From Group A, we collected and analyzed teachers’ reflections. The reflections were written at the end of 2019–20 school year. Teachers were asked to describe community-based activities they have implemented or plan to implement in class, to reflect on relationships they formed within the community, and to explain what made the PLC unique. A total of 24 reflections were received, 12 from each community.

We developed the questionnaire to understand how chemistry teachers cope with ERT versus routine teaching. Teachers’ work outside the classroom was covered, as well as pedagogy and technological challenges. Regarding teachers’ work outside the classroom, closed-ended questions were asked, including what challenges were significant, who supported them, and whom they assisted. Teachers’ challenges were ranked using a Likert scale. Other closed-ended questions included a list of support sources or contexts, and teachers could select multiple answers. Open-ended questions asked teachers about ERT support, such as: Describe instances when you received support during ERT? By whom? Was supporting other teachers empowering or a burden? What was unique in PLC’s support? And what would you recommend in future similar situations? Personal and demographic information was collected anonymously. Experts reviewed the questionnaire before it was administered electronically.

We used the questionnaire to answer the first research question, and interviews and reflections provided more insights into the quantitative results. Interviews and reflections were the basis for answering the second question. For answering the last question, we used all three research tools, looking at interviews, reflections, and answers to the open questions in the questionnaire.

2.4 Data analysis

In the questionnaire, teachers were asked to rate possible causes of stress during ERT. We used a Likert scale ranging from “I did not feel stressed” (5) to “I was not able to cope” (1); an option to mark items irrelevant to lockdowns was available. Exploratory factor analysis was used to explore factors among the items presented. In Table 1, we present the four factors found, examples of items, and Cronbach’s α values.

Additionally, we asked in the questionnaire to mark the collaborators they worked with. PLC members, family members, and friends were among the options given to the teachers. Multiple responses were allowed. Responses were grouped by type of support and weighed similarly.

Thematic analysis was used to analyze the texts of transcribed interviews, reflections, and answers to open-ended questions in the questionnaire. Analysis followed the steps detailed by Braun and Clarke (2006). The initial codes included descriptions of challenges faced and support described, and their type, i.e., emotional, social, or professional. Additional codes were defined during coding, to categorize all topics in the texts. Different researchers coded samples separately; differences were discussed, and codes were clarified by negotiated agreement (Watts & Finkenstaedt-Quinn, 2021). Finally, codes were related to the factors and results obtained from the quantitative analysis.

3 Results

Research question 1 dealt with the challenges teachers faced in addition to pedagogical ones during ERT. Teachers who answered the questionnaire, Group B, rated 15 items related to difficulties that could trigger stress, using the Likert scale described above. The four factors listed in Table 1 are shown in Figure 2, with error bars marking the
standard error. The lowest rating factors were related to Teaching materials and activities (A), and Teachers’ workplace (B). The lower score was related to difficulties during COVID-19 lockdowns, see description of the Likert scale above. Lower levels of stress were associated with the following factors: Support (C), and School environment and resources (D), which received higher scores.

Data were analyzed using a repeated measures procedure. Mauchly’s test indicated that the assumption of sphericity had been violated ($\chi^2(5) = 22.96, p < 0.001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.18$). Repeated measures analysis revealed a significant difference between the factor scores, $F(2.67, 309.95)= 24.97, p < 0.001$. Pairwise comparisons with Bonferroni adjustment of the $p$-values showed that there were significant differences ($p < 0.001$) between the following factor scores: A–D, A–C, B–D, and significant differences ($p < 0.005$) between factors B–C, see Figure 2.

The graph in Figure 2 shows that the low-rating factors differed significantly from the high-rating factors. The time-consuming task of obtaining and developing teaching materials (A), as well as workplace changes (B) posed the biggest challenges. Issues related to support (C) and changes in schools’ operation mode (D), such as teaching hours, instructions for matriculation exams, and contact with parents, were considered less problematic. The significance level varied: differences between factors (A)–(C), (A)–(D), and (B)–(D) were found to be significant with $p < 0.001$, and between factors (B)–(C) with $p < 0.005$. In the interviews, reflections, and open-ended questions of the questionnaire, we sought to understand why teachers ranked factors (A) and (B) as stress causes. Moreover, teachers’ recommendations for dealing with future emergencies were examined to better understand why these factors were rated as stress causes. To face challenges regarding Teaching materials and activities (A), teachers asked for assistance to cope with technology demands, which were not essential during routine times, as one teacher summarized: “Short-term, concise, fast training [programs] should be available … with short practice and a goal of applying technology in class.” (CTC member). The words “fast” and “short” emphasize the urgency of the situation. In addition, teachers suggested creating an option for online consultation with technical experts since they worked long hours from home. PLC support was described as a partial solution to that need since PLC activities were changed, not interrupted: “The PLC played a crucial role in initial remote teaching. I continuously learn new tools and teaching methods.” (CTC member).

Regarding the factor of Teachers’ workplace (B), teachers’ recommendations for the future varied. Several teachers emphasized the need for support for students, not for teachers. Others were direct in describing their predicament:

Human support is needed, not technology! Teacher support, encouragement, acknowledgment, and appreciation weren’t thought of. Instead, teachers were increasingly targeted from all directions. (LTC member)

According to this quote, emotional support was more important than technical support. As teacher guides or coordinators in their schools, some LTC members provided support and technological information. One LTC coordinator, who was also a Ministry of Education guide, described it as an added cause of stress:
Rachel (a colleague and teachers' guide) and I immediately planned a meeting for teachers. In a flash, I had to explain Zoom to teachers and create a meeting that required them to actively participate. As if I was 'thrown into deep water', I learned faster. (Yotam, LTC coordinator).

Teacher opinions on in-service training during ERT differed. For example, one view expressed contentment with the information available: “Any interested teacher can find the information. The Ministry of Education offered many training sessions I used.” (non-member teacher). Another quote further supported this view: “There were many courses, long and short. Additionally, lesson recordings and videos were available.” (CTC member).

However, others noted that in-service training on technology was not sufficient and offered too late, as one teacher described in the interview:

Unbelievable, we got Teams [Microsoft platform used online teaching] training months after the first lockdown … I already learned it myself, but I participated. (Orna, non-member teacher)

Another teacher suggested teachers should be awarded credits for learning technology: “To increase learning … [the Ministry of Education should] provide credits to teachers who participated in courses.” (CTC member).

Both quotes criticized the support provided by the Ministry of Education, local municipalities, and schools. Teachers claimed it came too late, their efforts were not rewarded, and that they were not encouraged. In our view, the adverse comments reflect the differing views, practices, and capabilities naturally found among teachers in routine. Moreover, we assumed that teachers rate monetary rewards differently.

The second research question addressed various members' perceptions of the PLC's activities during ERT in relation to support and teachers' needs. For this question, we analyzed interviews and reflections by teachers from Group A. An interviewee explained how the PLC's discussion of activities and technology aids was helpful:

Having heard others explain their problems and solutions, I tried Padlet [an application used in class] and it was excellent (Tzur, CTC member).

One CLC member emphasized cooperation among members:

During COVID [lockdowns], collaboration was amazing. All the teachers in the community shared online [teaching] tasks. I used many of them … (Amal, CTC member).

Both teachers, who are members of the PLC, highlighted the importance of discussions among teachers and the exchange of ideas. Chemistry teachers' support in PLCs was also tied directly to teaching chemistry topics from the curriculum. The activities teachers developed in the PLC were ready for implementation in class and answered teachers' immediate needs, for example, flexibility was noted in one of the activities that was developed in the PLC:

I remember when we worked in breakout rooms on the fatty acid worksheets [a topic learned as part of the curriculum]. There were variations … teachers worked with their students at home … pictures and sharing made it meaningful (Limor, LTC member).

An example of meeting teachers' needs was the development of an online unit on chemical energy by LTC teachers. The LTC coordinators noticed that many teachers began teaching this unit during lockdowns. Members divided topics, and each pair of teachers prepared an online lesson. All lessons developed were united in a self-learning unit and distributed to all members. At the end of the year, one teacher reflected:

In my opinion, the self-learning unit on chemical energy is a masterpiece that we will use often in the future. (Yafa, LTC member).

A link between technological tools and learning content contributed to the quality of support in PLCs. As part of the TPACK model (Mishra & Koehler, 2008), technological knowledge (TK) was described, in the description of initial exposure to Zoom in the first days of lockdowns. Technological pedagogical knowledge (TPK) was depicted, including Padlet and Zoom breakout rooms for engaging students in online courses. In our view, the energy teaching unit met the definition of TPACK as it was developed to use technology to teach a specific topic related to chemistry.
In the third research question, we examined teachers’ views of mutual assistance after the ERT experience. Based on reflections and interviews with Group A members, we found that teachers valued both the professional and emotional support they received in the community and linked them together. An LTC member wrote about both aspects when reflecting on PLC meetings: “The meetings were very significant to me during COVID [lockdowns]: socially, personally, and for ideas for online chemistry lessons.” (Yafa, LTC member). A similar linkage was found in the reflection of an experienced teacher who joined the CTC this year:

All members value the community … contributions range from personal and social to professional … realizing that the difficulties you face daily with students’ parents and staff are generally also the difficulties of colleagues … Consulting and sharing experiences are very important for professional and personal development. (Noa, CTC member)

In addition, this quote highlights the value of sharing challenges with colleagues in similar situations. This opportunity for sharing knowledge is natural within PLCs grouping teachers with similar tasks in their schools.

Although we did not inquire directly as to the area of professional support needed, technological or pedagogical, teachers used the open-ended questions in the questionnaire to express their personal views on the subject. Alongside the appreciation for support on the various technological aspects of teaching, teachers commented on the unbalanced attention given to technological know-how over discussions on aspects of Pedagogical Knowledge (PK) and Pedagogical Content Knowledge (PCK). An example of this opinion was clear from these quotes: “Learning was given less attention than technology. We need to stop this wave.” (CTC teacher) and “It takes time to learn technology tools, come up with remote teaching strategies, and implement them.” (LTC teacher).

Teachers’ views on supporting others, and their personal significance to them, were also examined. We used a multiple-answer question in the questionnaire in which teachers were asked to mark the context in which they supported other teachers and received 362 responses. Support contexts were divided into three categories which are given in Table 2 with the percentage of answers.

The results show that groups for chemistry teachers (for example PLCs or WhatsApp groups) were included in most answers. We included an open-ended question to inquire if supporting other teachers strengthened or burdened them. A total of 84 teachers responded, 90 % indicated that giving support strengthened them; 5 % described it as a burden; others were not decisive. PLC teachers described giving support from various aspects. For example, one teacher linked it to the teaching profession: “I enjoy learning and teaching others … sharing gives power … I was always happy to help with Zoom ” (CTC teacher). Another example was a teacher who wrote about helping friends: “I enjoy helping other teachers and relieving stress from friends” (LTC teacher). The mutual aspect of assistance was clear from the following quote: “It wasn’t support, we think together and try [ideas] together” (CTC member). Regarding difficulties, an LTC teacher shared:

The ability to support others always gives strength. Despite that, even the strongest and most efficient battery needs recharging, eventually. (LTC teacher).

Non-member teachers also noted supporting others was beneficial: “Sharing and helping [others] contributes to a deeper understanding of [teaching] tools” (non-member teacher).

An experienced teacher who initially joined a CTC and later joined the LTC and led her community described the PLC’s contribution in the aspect of mutual assistance in an interview:

The PLCs provided all-embracing support and made us better teachers, since [other members] served as role models. This became apparent once I participated in PLC activities. (Sharit, LTC member).

<table>
<thead>
<tr>
<th>Context of support</th>
<th>Percentage of answers</th>
</tr>
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<tbody>
<tr>
<td>Groups for chemistry teachers (PLCs or WhatsApp groups)</td>
<td>67 %</td>
</tr>
<tr>
<td>Schools</td>
<td>21 %</td>
</tr>
<tr>
<td>Other (personal requests or unspecified contexts)</td>
<td>12 %</td>
</tr>
</tbody>
</table>
This quote explains PLC's contribution in the aspect of mutual assistance. The teacher emphasized emotional support and working with others and related to the aspect of professional development. She related to the aspect of support in the PLCs as a component for advancing her and her colleagues to become better teachers. Participation in the PLC was emphasized, i.e., the importance of participation to the benefits she gained. Her growing involvement in communities, as she became a leader in her CTC, also demonstrated this.

4 Discussion

This study sheds light on Israeli chemistry teachers' work in ERT and their support needs, as well as on the role of chemistry PLCs in supporting teachers. The first research question explored the challenges chemistry teachers faced alongside pedagogical challenges. According to teachers' ratings of potential stress sources, four factors emerged: Teaching materials and activities (A), Teachers' workplace (B), Support (C), and School environment and resources (D). Other factors, related to pedagogical challenges, were described elsewhere (Shauly et al., 2023).

Teachers' views on the first two issues (factors A and B) differed significantly from their views on the other two topics. The reason for this may be the importance teachers place on teaching and working with students since these factors include items directly related to teaching students. Additionally, these two factors can directly be linked to lockdowns. Remote teaching had not been used extensively before the COVID-19 crisis, so teachers had to update and create teaching materials, thus increasing their workload. The increased workload was mentioned by teachers included in this study as well as by other authors (DeCoito & Estaiteyeh, 2022; Kim & Asbury, 2020; Kraft et al., 2021; Trust & Whalen, 2020; van der Spoel & Noroozi, 2020).

Teachers knowledge of assessment is part of teachers' professionalism, however, reported as higher level of teachers' knowledge and one which is difficult to develop (Dori & Avargil, 2014b). Assessment of learning was reported as the most difficult teacher pedagogical challenge during this period (Shauly et al., 2023); teaching high-order teaching skills was also difficult. These two factors relate to the factors found in the current study: Teaching materials and activities (A). These are related since ERT required teaching materials for online assessment and teaching thinking skills. Other studies have also demonstrated the importance of teachers' knowledge, especially TPACK and its components, to coping with ERT (König et al., 2020; Manokore & Kuntz, 2022). Pedagogical challenges reported by Shauly et al. (2023) also included knowing the learning characteristics of students. Among the factors not directly related to pedagogy, we did not find a matching factor. Therefore, we find that the results of this study support our results published earlier, showing the importance of support given by colleagues, since the support combines both professional and social needs.

Workplace changes (factor B) were also unique to this period, teachers were suddenly at home when teaching, not in schools. Working from home raised dilemmas concerning balancing home duties, such as caring for children with work-related duties. These dilemmas were also reported by other sources (e.g., Kim & Asbury, 2020; van der Spoel & Noroozi, 2020) as a cause for stress.

Time constraints and compromises over the quality of instruction caused teachers' stress. Teachers' continued commitment to their students was also reflected in this result. As an example, teachers did their best to complete teaching the full curriculum, despite eased matriculation exam requirements announced just before the end of the year. Studying teachers' strategies to cope with ERT academic requirements, researchers suggested developing teachers' TPACK (König et al., 2020; Manokore & Kuntz, 2022), and schools' support for teachers (DeCoito & Estaiteyeh, 2022; Kim & Asbury, 2020).

We believe these two factors (A and B) were higher with regard to stress because they embody the distinct differences between ERT and routine teaching, not directly related to pedagogy: the effort required to prepare online lessons and the consequences of social distancing. The need for support included in factor C might have been rated as a lower cause of stress because support was given by colleagues in PLCs, other teacher groups, as well as in schools. As members of the PLC described, mutual support among members was significant in meeting ERT challenges. This agrees with recommendations made by DeCoito and Estaiteyeh (2022) who noted the importance of school support and suggested forming in-school PLCs. Nevertheless, teachers also criticized the assistance offered and suggested improvements. The factor of School environment and resources (D), which face
included procedural and infrastructure changes, was not rated as problematic as reported in other literature sources. Researchers in other countries have found that unreliable internet availability and similar infrastructure challenges were more serious obstacles during ERT than teachers’ lack of knowledge and experience (Ferri et al., 2020; Korkmaz & Toraman, 2020; Rodríguez et al., 2021; Trust & Whalen, 2020). Our finding, that factor (D) caused less stress than factors (A) and (B) can be explained by different conditions in Israel, including shorter geographical distances. Another reason could be similar challenges teachers face in routine.

The second research question examined teachers’ accounts of PLC activities in relation to their perception of support. Members facing emotional and professional challenges benefited from PLC activities, which continued through lockdowns. Two aspects of emotional support were described. First, there was unity gained through sharing personal feelings. Secondly, empowerment came from the understanding that challenges were common among colleagues. This was consistent with the literature on PLCs grouping teachers with similar professional interests in routine times (e.g., Levy et al., 2020; Waldman, 2020).

Professional challenges were addressed by sharing resources and know-how on remote teaching. The TPACK model (Mishra & Koehler, 2008) was used to analyze assistance that enhanced teachers’ knowledge. Teachers shared basic knowledge related to the use of online technology (TK). Teachers described activities that contributed both to general pedagogical knowledge (TPK) and to know-how directly related to chemistry (TPACK). Moreover, PLCs were recommended for addressing subject-specific ERT challenges.

This study found that teachers did not differentiate between the nature of support. During thematic analysis, the different categories of support: emotional, social, and professional, were coded separately for a comprehensive analysis. Teacher reflections and interview transcripts reveal that teachers described all aspects together, commonly in the same sentence. We concluded that this linkage between both aspects of support points to the well-rounded support provided in the PLCs. Teachers described a variety of ERT needs and challenges in interviews and reflections. The stress due to loneliness during social distancing made professional challenges, for example, developing teaching materials and strategies for online lessons difficult. In PLCs, meeting all these needs are addressed, based on the common base of teaching chemistry. Communication with PLC members yielded a fruitful exchange of teaching materials, answered teachers’ professional needs and relieved feelings of loneliness. It agrees with PLC members’ preference for support from their colleagues over school and ministry sources (Shauly et al., 2023). Another example of teachers relying on colleagues teaching the same subject matter for support was demonstrated by Fackler and Sexton (2020), who studied a community of college teachers, all teaching Nature of Science (NOS), who formed a Facebook group during lockdowns to help them face with teaching challenges. A study of teachers’ work during ERT found that professional relationships led to close friendships (Kim & Ashbury, 2020). Kraft et al. (2021) studied teachers’ sense of success and well-being and advocated expanding support efforts by schools for teachers’ benefit and student benefit throughout the ERT.

The PLCs also offered real-time support. Real-time support in PLCs was mentioned in two contexts: one was support among members which highlighted the advantages of direct communication; the second was sharing online materials and recommendations. Teachers’ networks facilitated communication during social distancing periods. Teachers’ need for immediate assistance was noted by Hodges et al. (2021) as one of the salient differences between ERT and other forms of remote teaching. These needs were identified by teachers in Israel (Rap et al., 2020; Shauly et al., 2023) and worldwide (Cavanaugh & DeWeese, 2020; Fackler & Sexton, 2020; Hodges et al., 2021; Korkmaz & Toraman, 2020; Kraft et al., 2021). With criticism about the Ministry of Education, as support was offered too late and the need for technical support at the lockdown beginnings, the need for real-time support was obvious. The bottom-up approach of PLCs allowed for timely support (Hord, 2009; Orland-Barak, 2020; Vangrieken et al., 2017).

The last research question dealt with teachers’ perceptions of mutual assistance during ERT. Teachers’ reflective thoughts emphasized the advantages, strengths, and importance of grouping teachers of a specific subject, in this case, chemistry. Support offered by communities of teachers of the same subject was appreciated as it helped members deal with emotional and content challenges. This was noted by novice and experienced teachers.

Analysis based on the TPACK model (Mishra & Koehler, 2008) showed that teachers faced professional challenges related to PCK, not just technology-related issues. Teachers of the same subject naturally share content
and pedagogy knowledge. Therefore, PLCs, which group teachers who teach the same subject matter, enabled teachers to receive overall support which addressed a variety of their needs.

PLC membership was viewed as important for coping with daily challenges and improving teachers’ well-being. As teachers learned that their hardships were similar to those of others, they felt a sense of unity. This was the result of similar backgrounds and teaching positions. PLC membership allowed teachers to support colleagues. Providing support, not just receiving it, enhanced teachers’ knowledge, and well-being. Giving and receiving support both contributed to overcoming social distancing. The importance of colleagues’ support was also described by Kim and Ashbury (2020).

The conclusions of this research highlight the added benefit of mutual aid among colleagues, in supporting teachers who faced emotional, social, and professional challenges during ERT. Numerous factors caused stress for teachers, so a platform offering support in all aspects was appreciated. The results emphasize the combined benefits of communities of teachers in the same subject, already recognized in routine (e.g., Hamos et al., 2009; Levy et al., 2020; Vossen et al., 2020; Waldman, 2020), with the necessity of support during ERT (e.g., Hodges et al., 2021).

This study contributes practical insights into the substantial benefits gained by teachers who participated in PLCs grouping chemistry teachers. Participants’ positive PLC experiences during COVID-19 lockdowns and descriptions of mutual support can motivate teachers to join these communities. Leaders and coordinators can use this description to further strengthen teacher relations and cooperation. Using PLCs continuously in routine and future hardships is recommended as they provide emotional and professional support. This suggestion also emerged in other studies of teachers’ experiences during COVID-19 lockdowns (Kraft et al., 2021; Trust & Whalen, 2020).

The theoretical contribution of this study is relating PLC characteristics to PLC operation during ERT. Shared values and vision, collective responsibility, reflective professional inquiry, collaboration, and promoting group and individual learning are five features of PLCs (Stoll et al., 2006). Teachers’ statements revealed the five characteristics of PLCs. The joint effort for online teaching materials and willingness to share revealed shared values and vision. In addition to their personal benefit, teachers valued helping colleagues, exhibiting collective responsibility. Discussions among members led to a reflective professional inquiry during social distancing. Teachers’ examples of mutual assistance indicated collaboration. Moreover, teachers stressed the importance of the emotional and professional aspects of cooperation. Lastly, group and individual learning were related to TPACK for teachers’ knowledge.

Furthermore, this study emphasized the importance of teacher collaboration in the context of the subject taught. This was an extension of the PLC format created for school-based groups (Dufour, 2004; Hord, 1997). STEM teacher communities were established before the COVID-19 pandemic, and members continued to provide positive feedback during the crisis. Thus, it is advisable to explore the PLC format’s qualities further by exploring the relationships among its members and their social dynamics in routine and emergencies.

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