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# Perceived instructional leadership and teacher self-efficacy of online teaching in Taiwan: Mediating effects of teacher professional community

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## Abstract

This study aimed to examine the mediating effects of teacher professional community on the relationship between perceived instructional leadership and teacher self-efficacy of online teaching in Taiwan. Data were collected from elementary and middle school teachers via an online survey using a questionnaire designed with well-developed scales. Analysis showed that perceived instructional leadership has no direct effect on teacher self-efficacy and that teacher professional community mediates fully the relationship between perceived instructional leadership and teacher self-efficacy. Among the four teacher professional community components examined, shared norms showed the most significant mediating effect. Results also revealed no significant difference in the relationships between variables across teachers in elementary and middle schools. Implications for school leadership and teacher learning are discussed.

*Keywords*: teacher professional community, instructional leadership, teacher self-efficacy, online teaching, Taiwan

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## Introduction

Consequent to the outbreak of the coronavirus disease 2019 (COVID-19) in Taiwan, schools were closed with onsite classes replaced by remote schooling or online teaching (OT). Such a switch in teaching/learning mode changed drastically the interactions among the principal, teachers, and students, which used to be in the same physical space and setting. Instead, they had to play their school roles in their respective homes. Under such circumstances, the principal could neither conduct classroom walkthrough to observe and keep abreast of the teaching/learning process nor have personal interaction with the staff and students. This called for more effective and efficient school leadership, relying on relationships with their staff and stakeholders built and maintained through online connections rather than face-to-face conversations (Harris & Jones, 2022).

Current research has highlighted the lack of understanding of instructional practices that support student learning in online teaching and learning (Johnson et al., 2023). Moreover, OT poses problems to teachers including online teaching software not fully prepared or developed, unsure of whether students follow and master what is taught, inconvenience and difficulty in class management, and previous assessment methods that were no longer applicable (Qi & Meng, 2021). Decreased self-efficacy of teachers teaching online from home was found to be associated with a lack of experience in online teaching, separation of teachers from students, school administrative processes, and unsatisfactory student academic performance (Ma et al., 2021). Among the different antecedents of teacher self-efficacy (TSE) are principal leadership and support from colleagues (Tschannen-Moran & Hoy, 2007). In particular, instructional leadership (IL) behaviors at the individual level such as principals demonstrating high expectations for teaching, observing classes and giving feedback help foster greater sense of TSE (Day et al., 2011). Ma and Marion (2021) found that IL has both direct and indirect effects on TSE. However, the contribution of IL to TSE amidst problems and challenges of OT has not been explored.

Besides the principal, fellow coworkers are also the 'significant others' in the school setting, and the teacher professional community (TPC) plays an important role in enhancing TSE (Kennedy & Smith, 2013; Lee et al., 2011). In TPC, teachers discuss their experiences with their peers, observe successful experiences, and receive encouragement and feedback (Zheng et al., 2019). When interacting with colleagues, verbal persuasion and vicarious modeling can be sources of TSE. In Taiwan, the establishment of TPC is one of the educational reform strategies of the 12-Year Basic Education Curriculum Guidelines (Ministry of Education, 2019). It was mandated in the Guidelines that "Teachers should form professional learning communities to jointly explore and share teaching experiences; actively participate in on-campus and off-campus learning and training to receive latest information on educational developments; and make full use of social resources to improve their curriculum designs, teaching strategies, and learning assessments in order to improve students' learning outcomes" (Ministry of Education, 2019). In view of such emphasis on establishing TPC and its important

contribution to school quality development (Albrecht, 2019), this study aims to analyze the relationship between TPC and TSE in the OT context.

Prior research on TPC has distinguished its diverse components and explored their respective antecedents and consequences (Voelkel & Chrispeels, 2017). Investigation on the relationships among IL, TPC components, and TSE showed that IL had only indirect effects on TSE via the mediation of TPC components (Zheng et al., 2019). Inspired by Zheng et al. (2019), the current study revisits the impact of individual TPC components on the indirect relationship of IL with TSE in the OT context. Without loss of generalizability, the relationships are examined using single-level analysis with data collected at the individual teacher level. The research framework draws upon extensive research that has investigated both theoretical and empirical associations of school leadership with teaching and learning outcomes (Blasé & Blasé, 2000).

This study can contribute to expanding the related knowledge domains. First, it enhances the understanding of the roles IL behaviors play and how they function in the OT context. Second, it extends the TPC literature by investigating how teacher interaction in the TPC effects the TSE of OT. Third, the findings also serve as useful references in educational practice for enhancing TSE through IL by emphasizing the contributive aspects of TPC.

## Theoretical framework

### Perceived instructional leadership

Principal leadership which motives, supports and sustains the professional learning of teachers has a knock-on effect for both student learning and school improvement (Liu & Hallinger, 2018). Among the different principal leadership styles, instructional leadership (IL) has been empirically evidenced to be contributive to teaching and learning outcomes (Blasé & Blasé, 2000; Marks & Printy, 2003). Findings of Goddard et al. (2015) on 93 primary schools in the US showed that strong IL can create structures that facilitate teachers to strengthen organizational beliefs, which in turn promote student learning. Kim and Lee (2020) found that through mentoring and coaching programs, IL serves to develop teacher professionalism. Nevertheless, during the pandemic-necessitated lockdown, principals found that preparing students and teachers for online teaching and learning environments as well as communicating with all the stakeholder groups was particularly challenging (Thornton, 2021).

In this study, the role and influence of IL on TPC and TSE are explored at individual teacher level, namely teacher perceived IL. Specifically, if perceived IL of online teaching (IL-OT) reflects teacher perceptions of principal's leadership behavior in teaching leadership and classroom management as well as the principal's openness to sharing leadership specifically related to OT.

## Teacher self-efficacy

Originated from the social cognitive theory (Bandura, 1977), perceived self-efficacy refers to "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1995). According to this definition, in an educational setting, TSE is as an impetus for teachers to plan and implement better teaching activities, and is capable of enhancing student involvement in learning, even for those not eager to learn (Tschannen-Moran et al., 1998) and/or having difficulty to become more motivated (Tschannen-Moran & Hoy, 2001). Studies have shown TSE as a predictor of teaching effectiveness (Klassen & Tze, 2014), a key determinant of good instructional practice (Hatlevik, 2016), and a discriminant between effective and mediocre teachers (Tschannen-Moran & Hoy, 2001).

Pressley and Ha (2021) found that teachers who are teaching virtually have the lowest efficacy scores compared with those teaching in a hybrid or all in-person mode. Owing to the distinct features of a virtual classroom, teachers have to overcome less interaction and feedback, challenges for classroom control, and internet connection problems. Moreover, online teaching, which is different from face-to-face instruction, requires new pedagogical approaches. In this study, TSE of online teaching (TSE-OT) is taken as the consequence of TPC and reflects teacher's effectiveness in instruction, classroom management and student engagement in the OT context.

## Teacher professional community

A TPC is a working group of teachers with the same interest in forming a learning team for enhancing professional development (Hung et al., 2017) and in contributing to school improvement (Louis et al., 1996). Salleh (2016) highlighted the importance of TPC as a lever for school-based curriculum development so as to provide diverse learning experiences to students and achieve broader academic outcomes. Previous studies showed that teachers are more willing to accept suggestions and recommendations on how to improve teaching/ learning strategies and quality from fellow teachers (Supovitz et al., 2010; Wahlstrom & Louis, 2008) than from the principal. It is because teachers consider the advice from the principal a form of supervision, which undermines their professional autonomy (Rosenholtz, 1991).

According to Wahlstrom and Louis (2008), TPC can be interpreted in terms of four variables that describe the nature of a teacher's relationship with each other, namely reflective dialogue, collective responsibility, de-privatized practice, and shared norms. TPC-OT can be taken as teachers collaborating in groups to enhance online teaching and learning.

## Connections among the variables

### *Perceived IL-OT and TSE-OT*

Extensive research has investigated both theoretical and empirical associations of school leadership in relation to teaching and learning outcomes (Blasé & Blasé, 2000). The

contributive role of IL in enhancing TSE has been highlighted in empirical literature (Alanoglu, 2022; Ma & Marion, 2021). Specifically, Bellibas and Liu (2017) found that IL can predict teacher efficacy in teaching, managing the classroom, and engaging students. At the individual level, IL is related to the development of TSE through principals demonstrating high expectations for teaching, observing classes and giving feedback (Day et al., 2011). This study therefore proposes that teachers' perceived IL-OT has a direct and positive effect on TSE-OT.

### *Perceived IL-OT and TPC-OT*

IL has been shown to be a key factor influencing TPC (Hosseingholizadeh et al., 2020). Hallinger (2005) put forward three IL roles of the principal, which are namely defining the school's mission, managing the instructional program, and promoting a positive learning climate. Wahlstrom and Louis (2008) considered principal leadership an important element for TPC development. Liu and Hallinger (2018) found a direct effect of IL on TPC. In view of this perspective, this study proposed that perceived IL-OT has a direct and positive effect on TPC-OT.

### *TPC-OT and TSE-OT*

A study conducted by Zheng et al. (2021) on 39 primary schools in south-western Mainland China found a direct and positive effect of TPC on TSE. In addition, Zhang et al. (2020) critically investigated the effect of TPC on TSE in Shanghai, Mainland China, and also found that TPC significantly and positively affected TSE. A qualitative analysis on TPC in Iranian schools (Zonoubi et al., 2017) revealed that participation in TPC increased the self-efficacy of novice teachers in using innovative instructional strategies, implementing classroom management, and exercising their autonomy. In view of the above, this study proposed that TPC-OT has a direct and positive effect on TSE-OT.

### *Mediator role of TPC-OT*

According to Leithwood et al. (2017), principal leadership influences teacher learning through emotional, rational, family, and organizational paths. In such a framework, TPC can be taken as an organizational path through which principal leadership influences TSE (Zheng et al., 2019). An investigation conducted by Supovitz et al. (2010), in a Southeastern midsized urban U.S. school district, found that principal leadership indirectly influences teacher learning practices through TPC development and communication among school staff. Results obtained by Hallinger et al. (2014) found that principal leadership plays a major role in the development of TPC, which serves as a mediator in the relationship between principal leadership and teacher commitment. In addition, the findings of Liu and Hallinger (2018) on 186 middle schools in China concluded that IL contributes significantly to teacher professional learning, which serves as a mediator in the relationship between IL and TSE.

Hence, the current study proposes that TPC-OT mediates the effect of perceived IL-OT on TPC-OT.

In this research, four components of TPC proposed by Wahlstrom and Louis (2008), namely reflective dialogue (RD), collective responsibility (CR), de-privatized practice (DP), and shared norms (SN) are examined. In a functioning TPC, these four components are so deeply embedded that teachers are often unaware of them. For example, a teacher having a reflective dialogue with colleagues or inviting other teachers to observe a lesson would be normal, expected, and desirable (Little, 2003).

RD, viewed either as the maintenance of a dialogue or participation in reflective conversations in groups or pairs (Rarieya, 2005), helps fellow teachers gain new insights about teaching and instruction. Strong TPC is built on teachers engaging regularly in reflective dialogue with coworkers about their work and for assessing the quality of their teaching (Wahlstrom & Louis, 2008). CR is widely agreed upon as a form of teacher collective effort to improve meaningful learning for students (King & Newmann, 2001) and described as the extent to which teachers accept responsibility for student learning success at a school (LoGerfo & Goddard, 2008). Collective responsibility involves teacher learning and working together systematically on a regular basis to collectively ensure higher quality instruction in all classrooms and better results for all students.

DP refers to teachers sharing their teaching practices through inviting other teachers to help teach their class or to observe their teaching and provide feedback on their performance as well as visiting other teachers' classrooms to observe instruction. In DP, teachers swap their roles such as mentor, specialist, or advisor, and share new teaching methods to identify each other's strengths (Bryk et al., 1999). SN are a set of values and beliefs that are believed by the majority of teachers and become the basis for teachers in managing classrooms and student learning. These norms create social control mechanisms that serve to guide teachers, focus on increasing student learning opportunities and provide benefits to classroom teaching (Owen, 2015).

To conclude, prior research has found strong evidence that IL has direct and indirect effects on TSE (Liu et al., 2021) and that the principals' instructional practices contributed to teacher learning and collaborative practices among teachers (Bellibas et al., 2022). The mediating effects of professional learning community components on the relationship of IL with TSE have also been examined (Zheng et al., 2019). However, the above only discussed onsite teaching and learning environments. Little is known in regard to whether these findings remain valid in the OT context. Filling such a knowledge gap is the core goal of the present study. Figure 1 shows the research framework.

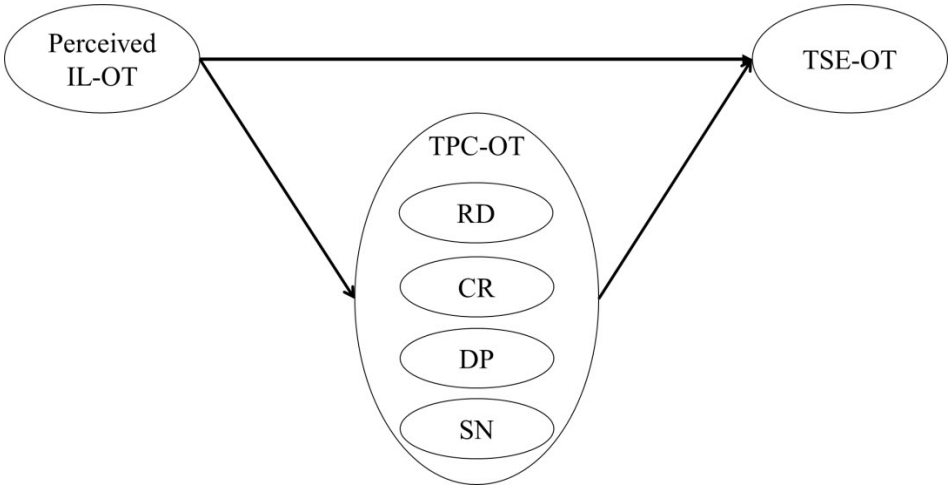


Figure 1. Research framework

## Method

### Participants

An online survey was conducted for three weeks in August 2021 in Taiwan. The survey targeted elementary and middle school teachers with OT experiences. Snowball sampling was carried out to identify potential study participants during the COVID-19 lockdown. Invitations to participate were sent to the authors' professional networks via e-mail and social media. These participants were then asked to forward the survey link to their networks of colleagues.

A total of 475 participants completed the online survey. There were more female (80.42%) than male teacher respondents (19.58%) in the sample, which was consistent with the population distribution of school teachers in Taiwan (Department of Statistics, 2022). Among them, 72.43% were elementary school teachers, 27.57% were middle school teachers; 19.16% had been teaching for more than 21 years, 17.26% for 16-20 years, 16.21% for 11-15 years, 27.58% for 6-10 years, and 19.79% for less than 5 years; 36% have bachelor's degree, 61.26% have master's degree, and 2.74% have a doctoral degree.

### Instruments

The questionnaire used in the survey comprised a total of 42 items adopted from three well-developed scales and modified for the online teaching mode. The three scales were originally in English and the Traditional Chinese version of the items adopted were

developed using the "back translation method" (Brislin, 1970). Teachers were asked to reply using a 7-point Likert scale with 1 for "strongly disagree", 2 for "disagree", 3 for "somewhat disagree", 4 for "neither agree nor disagree", 5 for "somewhat agree", 6 for "agree" and 7 for "strongly agree".

To assess the construct of perceived IL-OT, 14 items were adopted from the Instructional Leadership Scale developed by Goddard et al. (2015). There were 9 items on teaching leadership (TL), such as "The principal at this school is very knowledgeable about effective instructional practices of online teaching"; 3 items on teaching classroom monitoring (TCM), such as "The principal actively monitors the quality of online teaching in this school"; and 2 items on openness to sharing leadership (SL), such as "The principal develops a shared vision of what the online teaching of the school could be like". The Cronbach's Alpha for this 14-item subscale was .972. The confirmatory factor analysis (CFA) results showed good model fit of perceived IL-OT ($x^2/df$ = 3.868; GFI = .924; CFI = .905; RMSEA = .070) with the average variances extracted (AVE) for TL, TCM and SL of .745, .851 and .748, respectively.

To measure the construct of TSE-OT, 12 items were adopted from the Teacher Self-Efficacy Scale developed by Tschannen-Moran and Hoy (2001). There were 4 items on efficacy for online instructional strategies (EIS), such as "I can implement alternative online teaching strategies in my classroom"; 4 items on efficacy for online classroom management (ECM), such as "I can establish an online classroom management system with each group of students"; and 4 items on efficacy for student engagement (ESE) of online teaching, such as "I can make students value learning in the context of online teaching". The Cronbach's Alpha for this 12-item subscale was .951. The CFA results showed good model fit of TSE-OT ($x^2/df$ = 3.609; GFI = .942; CFI = .973; RMSEA = .074) with the AVE for EIS, ECM and ESE of .661, .785 and .738, respectively.

To evaluate the construct of TPC-OT, 16 items were adopted from the Teacher Professional Community Scale developed by Wahlstrom and Louis (2008). There were 5 items on RD, such as "The teacher had conversations with colleagues about development of online teaching curriculum"; 3 items on CR, such as "The teacher in the school feel responsible to help each other improve their instruction in the context of online teaching"; 4 items on DP, such as "The teacher in the school visited other teachers' online classrooms to observe instruction"; and 4 items on SN, such as "Most teachers in the school share a similar set of values, beliefs, and attitudes related to online teaching and learning". The Cronbach's Alpha for this 16-item subscale was .932. The Cronbach's Alpha for the subscales measuring RD, CR, DP and SN were .910, .876, .896 and .872, respectively. The CFA results showed good model fit of TPC-OT ($x^2/df$ = 3.456; GFI = .916; CFI = .958; RMSEA = .072) with the AVE for RD, CR, DP and SN of .665, .711, .693 and .641, respectively.

### Analysis

Description analysis and correlation statistical analysis were performed using IBM SPSS Statistics 24.0. Confirmatory factor analysis (CFA) and structural equation modeling (SEM) were conducted using Amos 24.0. CFA was first performed to examine whether the models of well-developed scales modified for online teaching fit the data well. For mediation assessment, indirect effects were examined using bootstrapping analysis (Hayes, 2009).

Two structural models, Model 1 and Model 2, were used in this study. Model 1 assessed the significance of relationships among perceived IL-OT, TPC-OT, and TSE-OT so as to confirm the mediating role of TPC-OT. The indirect effects of perceived IL-OT on TSE-OT via every TPC-OT component were examined specifically in Model 2. The results can serve as references for TPC development in practice.

Multigroup analysis (MGA) was further performed to explore whether the relationships between variables might differ across teachers serving in different educational settings. The respondents were divided into two groups, namely elementary school teachers and middle school teachers. First, the standard model (unrestricted model), which allows different path coefficients between groups, was applied, thus yielding a chi-square value ($\chi^2_{unre}$). Then, the restricted model, which constrains all path coefficients of both groups to be equivalent, was applied, thus obtaining another chi-square value ($\chi^2_{re}$). The standard model and the restricted model are both nested models that can be statistically compared. A significantly lower $\Delta\chi^2$ value for the standard model ($p < .05$) indicates a poorer fit of the restricted model. The hypothesis with the same path coefficients across groups is rejected (Hair et al., 2009).

## Results

### Relationships between variables

Table 1. Means (*M*), standard deviations (*SD*) and correlations among study variables

| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 1. Perceived IL-OT | 5.04 | 1.32 | - | | | | | |
| 2. TPC-OT | 5.43 | .87 | .549** | - | | | | |
| 3. RD | 6.07 | .78 | .345** | .771** | - | | | |
| 4. CR | 5.76 | .97 | .457** | .836** | .648** | - | | |
| 5. DP | 4.78 | 1.36 | .381** | .851** | .511** | .553** | - | |
| 6. SN | 5.02 | 1.13 | .637** | .848** | .479** | .705** | .617** | - |
| 7. TSE-OT | 5.65 | .84 | .330** | .572** | .465** | .464** | .472** | .493** |

*Note.* $N = 475$; $^{**}p < 0.01$

Table 1 lists the mean, standard deviation, and correlation among the different constructs. As can be seen, TSE-OT had the highest mean ($M = 5.65$; $SD = .84$), followed by TPC-OT

(*M* = 5.43; *SD* = .87); and IL-OT (*M* = 5.04; *SD* = 1.32). Moreover, perceived IL-OT was positively and significantly associated with TPC-OT (*R* = .549, *p* < .01) and TSE-OT (*R* = .330, *p* < .01); and TPC-OT were positively and significantly associated with TSE-OT (*R* = .572, *p* < .01).

## SEM results

### *Model 1 – relationships between perceived IL-OT, TPC-OT, and TSE-OT*

The goodness-of-fit statistics showed that Model 1 had a good data fit ($x^2/df$ = 3.954; GFI = .953; CFI = .972; RMSEA = .079). Figure 1 shows the SEM results of relationships between variables in Model 1. As can be seen, perceived IL-OT was significantly related to TPC-OT (β = .30, *p* < .001) and TPC-OT had a significant effect on TSE-OT (β = .75, *p* < .001). In contrast, the effect of perceived IL-OT on TSE-OT was insignificant, as shown by the low path coefficient of -.02 (*p* > .001). Moreover, the indirect mediation effects are supported, evidenced by the absence of zero in the bootstrap 95% confidence intervals (CI). In other words, TPC-OT mediates the positive relationship between perceived IL-OT and TSE-OT (.23, 95% [.174, .296]). Taken together and in the absence of a direct effect, the results reveal full mediation of TPC-OT between perceived IL-OT and TSE-OT.

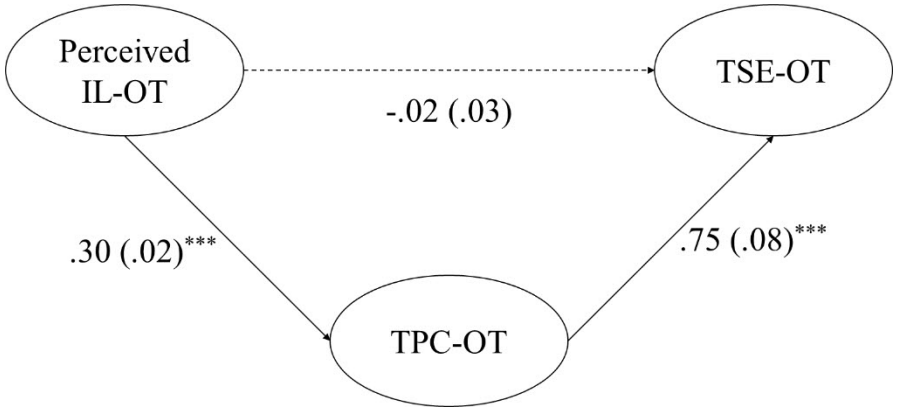


Figure 2. Results of relationships between variables in Model 1

*Note.* SE in parentheses; ***$p$ < .001

### *Model 2 – relationships between perceived IL-OT, TPC-OT components, and TSE-OT*

The goodness-of-fit statistics showed that Model 2 had a good data fit ($x^2/df$ = 2.567; GFI = .829; CFI = .939; RMSEA = .057). Figure 3 shows the SEM results of relationships between variables in Model 2. The results showed significant and positive effects of perceived IL on all four components of TPC-OT, including RD (β = .43, $p$ < .001), CR (β = .59, $p$ < .001), DP (β = .48, $p$ < .001) and SN (β = .86, $p$ < .001). Regarding the effects of TPC-OT components on TSE-OT, RD (β = .22, p < .001), CR (β = .16, $p$ < .005), DP (β = .25, $p$ < .001) and SN (β = .39, $p$ < .001) significantly predicted TSE-OT. Table 2 shows the results of mediation analysis on 1000 bootstrapping samples.

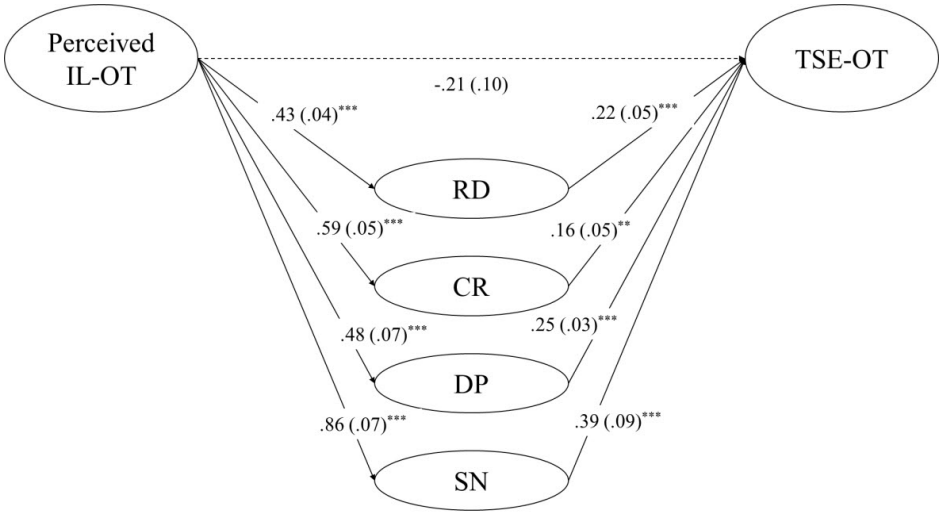


Figure 3. Results of relationships between variables in Model 2

*Note.* SE in parentheses; $^{***}p$ < .001; $^{**}p$ < .005

Table 2. Mediation analysis of TPC-OT components on effects of IL-OT on TSE-OT

| | | Mediation analysis | | |
|---|---|---|---|---|
| Dependent variable | Independent variable | Mediation variable | Estimates | 95% CI |
| TSE-OT | Perceived IL-OT | RD | .07** | [.01, .14] |
| | | CR | .07** | [.01, .15] |
| | | DP | .09*** | [.04, .17] |
| | | SN | .26*** | [.10, .49] |

*Note.* $^{***}p$ < .001; $^{**}p$ < .005

As seen in Table 2, the bootstrap test accepted the mediation effect of all components of TPC-OT. The indirect effects of perceived IL-OT on TSE-OT via RD, CR, DP and SN are .07, .07, .09 and .26, respectively.

## MGA results

As stated earlier, among the respondents 72.43% were elementary school teachers, 27.57% were middle school teachers. MGA results shown in Table 3 revealed the effects of perceived IL-OT on TPC-OT (.32, .27, respectively), of perceived IL-OT on TSE-OT (-.02, -.03) and of TPC-OT on TSE-OT (.73, .86) for both elementary and middle school teachers. The differences in chi-square values of the three relationships above when assessed by standard and restricted models $\Delta\chi^2$ are .02, 1.02 and .53 with $p$ = .894, .312 and .467, respectively. Thus, the hypothesis with the same path coefficients across groups is accepted. The empirical results showed no significant difference in the relationships between perceived IL-OT, TPC-OT and TSE-OT as in Model 1 across teachers in elementary and middle schools.

Table 4 shows the MGA results of path coefficients of perceived IL-OT, TPC-OT components, and TSE-OT. The differences in chi-square values of the relationships when assessed by standard and restricted models $\Delta\chi^2$ are .21, .41, .25, 2.77, 1.93, 3.55, 3.53, .21 and .69 with $p$ =.648, .523, .618, .096, .165, .060, .060, .649 and .405, respectively. With all p-values larger than .05, the hypotheses that the path coefficients are the same across groups are accepted. In other words, there is no significant difference in the relationships between perceived IL-OT, TPC-OT components and TSE-OT as in Model 2 across teachers in elementary and middle schools.

Table 3. MGA results of path coefficients of perceived IL-OT, TPC-OT, and TSE-OT in different educational settings

| | Elementary school | | Middle school | | Compared with unrestricted model |
|---|---|---|---|---|---|
| Path | β | $p$ | β | $p$ | $\Delta\chi^2$ ($df$ = 1) |
| Perceived IL-OT→TPC-OT | .32 | <.001 | .27 | <.001 | .02 ($p$ = .894) |
| Perceived IL-OT→TSE-OT | -.02 | .621 | -.03 | .603 | 1.02 ($p$ = .312) |
| TPC-OT→TSE-OT | .73 | <.001 | .86 | <.001 | .53 ($p$ = .467) |

β = unstandardized path coefficient

Table 4. MGA results of path coefficients of perceived IL-OT, TPC-OT components and TSE-OT in different educational settings

| Path | Elementary school | | Middle school | | Compared with unrestricted model |
|---|---|---|---|---|---|
| | β | *p* | β | *p* | $\Delta\chi^2$ (*df* = 1) |
| Perceived IL-OT→RD | .35 | <.001 | .30 | <.001 | .21 (*p* = .648) |
| Perceived IL-OT→CR | .54 | <.001 | .48 | <.001 | .41 (*p* = .523) |
| Perceived IL-OT→DP | .71 | <.001 | .45 | <.001 | .25 (*p* = .618) |
| Perceived IL-OT→SN | .89 | <.001 | .68 | <.001 | 2.77 (*p* = .096) |
| Perceived IL-OT→TSE-OT | -.18 | .121 | -.28 | .142 | 1.93 (*p* = .165) |
| RD→TSE-OT | .29 | <.001 | .05 | .592 | 3.55 (*p* = .060) |
| CR→TSE-OT | .05 | .328 | .34 | .003 | 3.53 (*p* = .060) |
| DN→TSE-OT | .13 | <.001 | .16 | .004 | .21 (*p* = .649) |
| SN→TSE-OT | .32 | .002 | .54 | .019 | .69 (*p* = .405) |

## Discussion

The current study aimed to gain more refined insights into how IL effects TSE under the mediation of TPC in the OT context. In line with prior research recommendations and in view of the spatial and pedagogical differences between onsite and online teaching, this study considered respective components of TPC as independent variables and explored their mediating effects. The present findings enrich the instructional leadership literature on how IL functions in the OT context.

Principals, as instructional leaders, can promote TSE by observing class instruction and providing feedback and by developing a positive learning climate for teachers (Çalik et al., 2012). Extensive research has shown theoretical associations of IL and TSE (Alanoglu, 2022; Bellibas & Liu, 2017; Ma & Marion, 2021). While previous research has evidenced the positive influence of IL on TSE, the present findings revealed neither direct nor significant impact of perceived IL on TSE in the OT context. On one hand, with most teachers teaching online from home during the pandemic, it is difficult if not impossible for the IL of principals to have any direct effect on TSE. On other hand, the insignificant effect observed echoed the research results obtained by Zheng et al. (2019) in China, which is characterized by hierarchical power structures and collectivism. Similarly, collectivism rather than individualism is also prevalent in Taiwan (Ali et al., 2005).

IL has been shown to be a key factor influencing TPC (Hosseingholizadeh et al., 2020; Liu & Hallinger, 2018). Empirical data obtained from the survey evidenced the positive and significant effect of perceived IL on TPC in the OT context. These results echoed prior findings in the context of onsite teaching that IL is a key factor in fostering the establishment of professional learning communities (Liu & Hallinger, 2018; 2022).

Literature has shown that TPC plays an important role in enhancing TSE (Kennedy & Smith, 2013; Yada et al., 2023; Yoo & Jang, 2022). Participation in TPC increased TSE in terms of innovative instructional strategies, implementing classroom management, and teachers exercising their autonomy (Zonoubi et al., 2017). Analysis results evidenced the positive and significant effect of TPC on TSE in the OT context. That is, the decreased self-efficacy of teachers teaching online from home can be improved by participating in TPC.

TPC has been taken as an organizational path through which principal leadership influences TSE (Zheng et al., 2019). The current results showed that TPC-OT mediates the effect of perceived IL-OT on TPC-OT. This is in line with findings of Liu and Hallinger (2018) that IL contributes significantly to teacher professional learning, which serves as a mediator in the relationship between IL and TSE. Moreover, the full mediation of TPC-OT between perceived IL-OT and TSE-OT found in this study is consistent with the results reported by Ma and Marion (2021) that IL practices have more indirect than direct impacts on teacher efficacy. The full mediation of TPC-OT in the effect of perceived IL-OT on TSE-OT demonstrates the important role of TPC in influencing IL to enhance TSE especially in the OT context.

The present findings also evidenced the significant mediating effect of the four TPC components in the OT context and echoed Özdemir (2019) that principal leadership practices effect the instructional practices of teachers via shared responsibility and de-privatized practice. Results revealed SN having the most significant mediating effect ($\beta$ = .26) far exceeding that of RD ($\beta$ = .07), CR ($\beta$ = .07) and DP ($\beta$ = .09), and contrary to the findings of Zheng et al. (2019) for onsite teaching. The discrepancy may be attributed to the two different teaching modalities. In the OT context with little interaction and collaboration among teachers, RD, CR and DP can hardly be realized, thus undermining their effects on TSE. In contrast, shared vision and beliefs promoted through TPC and internalized by teachers can contribute to TSE enhancement. Hence, even without direct supervision of principals or physical interaction with coworkers, teachers can feel confident and effective when facing OT challenges.

The MGA results showed no significant difference in the relationships between perceived IL-OT, TPC-OT components, and TSE-OT across teachers in elementary and middle schools. Although elementary and middle schools have different educational goals, and teachers in elementary schools teach every subject while there are different teachers for each subject in middle schools, the importance of TPC in enhancing TSE of OT is the same.

## Conclusions and implications

The purpose of the study is to examine the relationships between perceived IL, TPC components, and TSE in the OT context. Results showed that perceived IL-OT has no direct effect on TSE-OT and TPC-OT fully mediates the relationship of perceived IL-OT with

TSE-OT. In addition, though all four components were found to be significant mediators, SN showed the most significant mediating effect. These findings extend existing literature on TPC and enhance understanding of the paths through which school leaders can exert influence on teachers and their instructional efficacy.

In fact, principals can implement IL not only at school but also online by setting the tone and expectations of teaching for teachers and of learning for students. Though principals may have little experience of putting IL to practice when establishing and maintaining online teaching and learning programs, they can still provide ideas, encouragement, and support to the teachers. Besides encouraging teachers to form and join a TPC, principals should minimize distance from teachers, be committed to meaningful and in-depth discussions with teachers, and promote harmony with and among teachers. Furthermore, principals can convey the spirit of teaching as a profession to teachers through both formal and informal channels. At meetings and within communities, principals can instill the idea that teachers help shape their students' futures, and praise or reward teachers who perform well in OT. When interacting with teachers, principals can communicate the school's vision and mission to foster solidarity, making shared norms the basis for teachers' classroom management and student learning. Through social control mechanisms, principals can improve TSE and teaching quality in OT.

In conclusion, while the present findings have important implications, this study suggests further investigation to consider schools' background information. While this study looked at three focused constructs, future research can take into account more background variables that might effect TPC and TSE, such as school size and student composition. We deal only with the constructs at the teacher level. Lastly, multilevel SEM or hierarchical linear model regression can be conducted to investigate the differences between perceived IL and TPC at the school level and TSE at the individual teacher level.

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