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When the School Door Closes, Do Teachers Open a Window? Using Mixed Methods to Investigate Teachers' Online Teaching Practices and Momentary Experiences in Crisis

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Abstract: The crisis of COVID-19 significantly disrupted global education and overturned our understanding of classroom setting in secondary education. This study adopted a mixed methods design to categorize the daily instructional practices of teachers in the early stages of school closure using content analysis and to test the resulting framework using ANOVA. A total of 48 teachers provided five-day diary entries in which they recorded episodic activities and subjective experiences, reported daily teaching techniques, and rated their subjective teaching quality. Four emergent online teaching orientations emerged from the data: 1 nonreciprocal knowledge understanding (1NRKU), 2 nonreciprocal knowledge construction (2NRKC), 3 reciprocal knowledge understanding (3RKU), and 4 reciprocal knowledge construction (4RKC). The results also showed that teachers adopting different online teaching orientations described their experiences differently. Teachers adopting 2NRKC, 3RKU, and 4RKC experienced significantly higher daily teaching satisfaction; teachers adopting 3RKU and 4RKC perceived significantly better student engagement. In terms of teaching readiness, teachers adopting 2NRKC, 3RKU, and 4RKC had significantly more experiences of online professional development and significantly better distance teaching TPCK. This study is innovative in presenting momentary data, which sheds light on future programs for customized professional development that will help prepare teachers for the next educational crisis.

Keywords: COVID-19 pandemic, online teaching orientations, mixed methods

1. Introduction

In a recent review study of the impact of the COVID-19 pandemic on teaching and learning worldwide, Pokhrel and Chhetri (2021) summarized the challenges and opportunities that teachers and learners faced. They concluded that despite the increase in pandemic-relevant studies, further exploration should be carried out to investigate what types of effective online pedagogies have been adopted to keep learning sustained. A further investigation into studies focusing on teachers' first-hand experiences and perceptions of online teaching under the threat of COVID-19 reveals that these direct reports have significant limitations. First, they were insufficiently grounded in existing theories or frameworks, so meaningful insights could not be drawn from previous endeavors on distance teaching or relevant issues to explain and interpret the apparent chaos. Second, they mainly collected cross-sectional data via open-ended surveys, interviews, questionnaires, or mixed-methods design (Alea et al., 2020; Baker et al., 2021). These data were sufficient for a preliminary investigation with quick summaries of the emergent situations but failed to zoom in to rich details that witnessed emergency remote teaching (Whittle et al., 2020) in a more complex way.

The purpose of this study is twofold. First, it aims to categorize teachers' pedagogy for five teaching days in the initial phase of school closure. Second, it intends to collect cross-sectional and repeated data to reveal teachers' experiences of the sudden and complete shift of instruction from the traditional face-to-face environment to the virtual world. In other words, we want to explore, when school doors were closed during the pandemic outbreak, did teachers effectively open a window for

students to access learning remotely? If so, what kinds of windows did they open? What did they feel about their teaching and student learning at the critical moments when they opened the window-a pedagogy for which they had received little training

2. Theoretical Background

2.1. Emergency Remote Teaching and Online Teaching Readiness

Emergency remote teaching is proposed by Whittle et al. (2020). They introduced a model to highlight the uniqueness of unplanned and responsive remote teaching resulting from emergent crises. They suggested including teachers with a broader range of teaching experiences in the study. A longitudinal study that could reveal changes in teachers should be carried out. The present study addresses these suggestions by collecting repeated data from both novice and experienced teachers.

Among the various TPCK questionnaires that have been developed, the one proposed by Chai et al. (2013) caught our attention for a few reasons. First, the instrument was validated with an Asian sample of 550 pre-service teachers in China, Hong Kong, Singapore, and Taiwan, so the items were presented in Chinese (p.45-48), the first language the participants knew. Besides, the instrument has been adopted to measure TPCK of in-service teachers (Dong et al., 2015), who are identical to the participants. So far, few previous studies have viewed TPCK in the unique context of complete online distance teaching, so it is worth exploring its role in supporting teachers to do emergency remote teaching. Since online teaching requires greater technology-related knowledge, we decided to narrow down and focus on teachers' holistic technology-centered knowledge of TK (technology knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPCK (technological pedagogical content knowledge). We coined "distance teaching TPCK" to describe this context-specific construct.

2.2. Subjective Teaching Quality: Teachers' Optimal experience, Teaching Satisfaction, and Perceived Student Engagement

The sudden shift to virtual learning environment caused by the COVID-19 pandemic ushers in global concerns about online teaching quality (United Nations, 2021; Seufert et al., 2021). This study focuses on teachers' subjective evaluations of teaching quality, including their perceptions of the momentary experience, teaching, and students' learning. When it comes to perceptions of experience, Csikszentmihalyi's (1990) flow theory has attracted much attention. This theory explains how deep engagement occurs when people work on challenging but not overwhelming activities. Csikszentmihalyi (1997) later noted that if teachers are in flow, students tend to experience flow (p. 33). This contagious effect has been empirically demonstrated (Bakker, 2005; Culbertson et al., 2015), but direct investigation on teachers' optimal experience in the classroom has been limited (Basom & Frase, 2004).

Beard and Hoy (2010) were one of the few studies to provide empirical evidence of teachers' optimal experience. They viewed teachers' flow experience as a holistic integration of the nine dimensions proposed by Nakamura and Csikszentmihalyi (2009): three antecedent conditions (i.e., challenge-skill balance, clear goals, and immediate feedback) and six elements of a subjective state (i.e., concentration on the task, action-awareness merging, loss of self-consciousness, sense of control, time distortion, the activity as intrinsically rewarding).

In addition to teachers' optimal experience, faculty satisfaction has also been used to evaluate the quality of online courses. It has been shown to be positively correlated with student satisfaction (Bolliger & Wasilik, 2009; Hartman et al., 2000). Interestingly, when Bolliger and Wasilik (2009) conducted an online faculty satisfaction survey, about one-third of the 28 items were related to teachers' perception of student engagement in the classroom.

Another common criterion is student engagement. Martin and Bolliger (2018) found that how teachers selected materials, presented knowledge, and employed pedagogical strategies was almost determinant of how engaged students were in class. Besides, online learners reported a higher mean score of engagement in learner-to-instructor strategies than in learner-to-content and learner-to-learner

strategies. These findings are not consistent with the longitudinal study by Muir et al. (2019). In other words, pedagogies and student engagement are two sides of one coin. Daily variation of the instructions leads to fluctuation of student engagement over time.

2.4. Current Study

The following research questions are intentionally asked:

- RQ1: What emergent online teaching orientations could be found in teachers' teaching logs kept during the initial stage of emergency remote teaching?
- RQ2: Did teachers applying different emergent online teaching orientations report significant differences in subjective teaching quality and online teaching readiness?

We collected nested data that fell into three types (see Figure 1): (1) person-based variables, which included online teaching readiness (i.e., online professional development experience and distance teaching TPCK); (2) daily teaching variables, which were emergent online teaching orientations and two variables of subjective teaching quality (i.e., teaching satisfaction and perceived student engagement); (3) the episodic variable, which was the last variable of subjective teaching quality (i.e., the optimal experience of teaching-related activities).

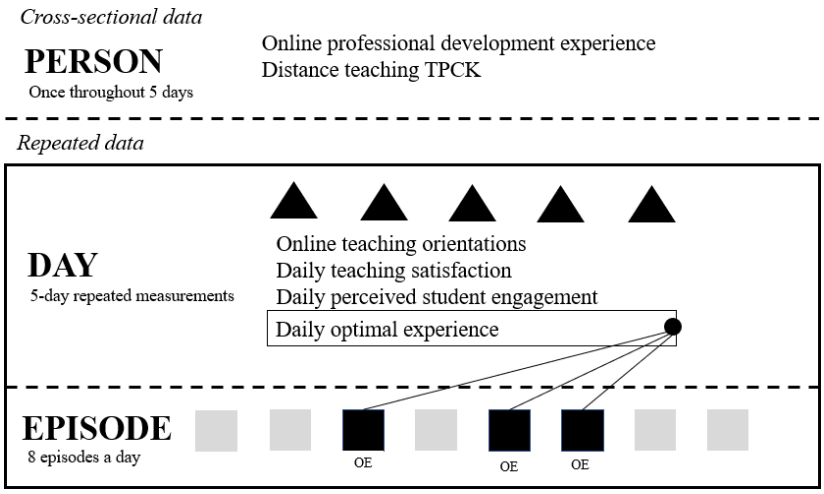


Figure 1. Three-level data structure of the current study.

Note. At the episode level, OE refers to Optimal experience. Black and grey cubes represent eight daily activities teachers reported per day. Black cubes represent teaching activities, which are the main source of this study. The lines and the framed square show episodic data are aggregated to form daily optimal experience at the Day level. Gray cubes refer to nonteaching activities (e.g., feeding children, watching movies with family, etc.), excluded from data analysis. At the day level, triangles represent five teaching days.

3. Method

3.1 Participants

Right after the government in Taiwan announced the closure of schools at the end of May 2021, an online invitation was sent to high school teachers. Initially, 50 teachers were recruited as participants, but two of them were excluded because they could not contribute a complete record of five working days. The majority of the 48 recruited teachers were female (73%) and formal teachers (88%), whose average teaching experience was 12.5 years (ranged from 1.5 to 30 years). Half of them (50%) had children staying at home with them while they were working at home.

3.2 Instruments

Three instruments were used in this study. The first instrument, Daily Diary, documenting participants' eight episodes of daily activities throughout the day, was adapted from Cheng et al. (2017). A total of

1,984 were collected from late May to early June 2021. This instrument consists of three parts. Part one is diary writing whose purpose was to help participants recall details of what they had done on the previous day from their memory (Kahneman et al., 2004). In part two, they divided the content written in part one into eight serial episodes. They had to give each episode a descriptive tag, such as "Teaching," "Preparing for the class," "Doing exercise," etc. Only episodes tagged "Teaching" were analyzed (1,092 events in total, 55%). In part three, participants answered structured questions about each episode. These questions can be divided into two types. The first type captures the characteristics of each episode, including *When* the episode began and ended, *What* they were doing, *Where* they were, *Whom* they were with, and *How* they perceived the episode. The other type measures participants' subjective experience, defined by nine indicators of optimal experience in Flow theory (Cheng et al., 2017) on a nine-point Likert scale.

The second instrument, Teaching Log, is a structured daily questionnaire consisting of two parts. In part one, participants described their online teaching practices by checking boxes from six categories (i.e., delivery types, teaching materials, platforms, websites, tools, and procedure of the class). They could provide additional text descriptions if necessary. Following Saldaña's (2015) manual, two coders coded the data into four types of measures: Delivery Types, Innovative Adds-On, Teaching Processes, and Interactive Activities. Delivery Types refer to how teachers delivered the class. Participants could choose between synchronous, asynchronous, and mixed modes. Innovative Adds-On indicates whether participants included additional online materials in addition to the digitized textbooks. This measure was coded from boxes regarding participants' teaching materials (e.g., self-made videos, worksheets other teachers designed, free interactive applications, etc.). Teaching Processes refer to the activity's agency (who initiates the behavior). This measure was coded into three categories (i.e., teacher-centered, student-centered understanding focused, and student-centered construction focused) from boxes concerning teaching activities exerted in class (e.g., teacher lecturing, teacher demonstration, group discussion, etc.). Interactive Activities focus on whether participants emphasized classroom interaction. This measure was coded from boxes about online learning software (e.g., Kami, Class Dojo, Kahoot, etc.) into three purposes: quizzes, games, and discussion. The coding of the data is further explained in Section 3.2.1. In part two, participants answered two questions on a 9-point Likert scale, one on teaching satisfaction ("Overall, were you satisfied with today's teaching?") and the other on perceived student engagement ("Overall, were your students engaged in today's learning?"). These two items were indicators of subjective teaching quality.

In the third instrument, Personal Profile, participants answered questions relevant to personal information and online teaching readiness (i.e., online professional development experience and distance-teaching TPCK). Online professional development experience refers to whether participants had experience with online instruction and participation in online learning activities prior to the COVID -19 pandemic. As for distance-teaching TPCK, it was measured by four subscales focusing on technology developed by Chai et al. (2013).

3.2.1 Coding Process for Emergent Online Teaching Orientations

Data collected by Teaching Log were initially coded into four measures (i.e., Delivery Types, Innovative Adds-On, Teaching Processes, and Interactive Activities). Based on a holistic evaluation of the measures, we developed a framework to categorize teaching days (237 teaching days reported by 48 teachers for five days; missing data were because some participants did not have classes on certain days) into four emergent online teaching orientations (see Figure 2). Two e-learning experts, following Saldaña's (2015) manual, conducted the coding. To test the reliability of their judgments, we relied on Cohen's (1960) Kappa coefficient κ as an inter-rater agreement and Landis and Koch's (1977) standard to explain the meaning of the Kappa value. The Kappa coefficient was 0.914, indicating near perfect agreement between raters (McHugh, 2012). See the Results section for a detailed explanation of the framework.

3.2.2 Statistical Analyses

We used SPSS 21 software for statistical analyses. First, Chi-square tests were applied to determine whether four types of measures (i.e., Delivery Types, Innovative Adds-On, Teaching Processes, and Interactive Activities) showed significant statistical differences among the four emergent online

teaching orientations. The results were used to answer RQ1. Second, to answer RQ2, we conducted one-way analyses of variance (ANOVA) with LSD post hoc tests to explore whether the types of emergent online teaching orientations were associated with participants' subjective teaching quality and with their online teaching readiness. It is important to note that daily optimal experience was aggregated from episodic optimal experiences (Figure 1).

4. Results

4.1. RQ1: What emergent online teaching orientations could be found in teachers' teaching logs kept during the initial stage of emergency remote teaching?

Based on the coded data from Teaching Log, we found a quadrant diagram for the emergent online teaching orientations (see Figure 2). Each emergent online teaching orientation (i.e., 1 nonreciprocal knowledge understanding (NRKU); 2 nonreciprocal knowledge construction (NRKC); 3 reciprocal knowledge understanding (RKU); and 4 reciprocal knowledge construction (RKC)) is followed by explanations and typical examples.

To determine whether the four measures of the teaching practices (e.g., *Delivery types*, *Innovative adds-on*, *Teaching processes*, and *Interactive activities*) were equally distributed in the four emergent online teaching orientations, we performed four chi-square tests of goodness-of-fit. As Table 1 shows, the four measures were not equally distributed across the emergent online teaching orientations ($\chi^2_{(6,237)} = 35.26$, $p < .001$; $\chi^2_{(3,74)} = 40.38$, $p < .001$; $\chi^2_{(6,1590)} = 183.81$, $p < .001$; $\chi^2_{(6,231)} = 61.17$, $p < .001$).

1NRKU (nonreciprocal knowledge understanding) was similar to face-to-face classroom setting where teachers aim to deliver knowledge and have limited interaction with students. As shown in Table 1, teachers adopting 1NRKU tended to use more synchronistic delivery type (64.5%) and some asynchronistic delivery type (25.8%). They used very few innovative adds-on materials (3.2%) but many teacher-centered activities (90.6%) and interactive quizzes (97%).

2NRKC (nonreciprocal knowledge construction) was featured by teachers providing videos and materials, asking students to engage in online self-directed learning activities where students worked alone to construct knowledge with limited interaction with the teacher (see Figure 2). As Table 1 shows, 2NRKC teachers chose more synchronistic delivery type (66.7%) and did not use many innovative adds-on materials (10.3%). They used similar amount of teacher-centered and student-centered activities (44.9% versus 55.1%) and many interactive quizzes (88.7%).

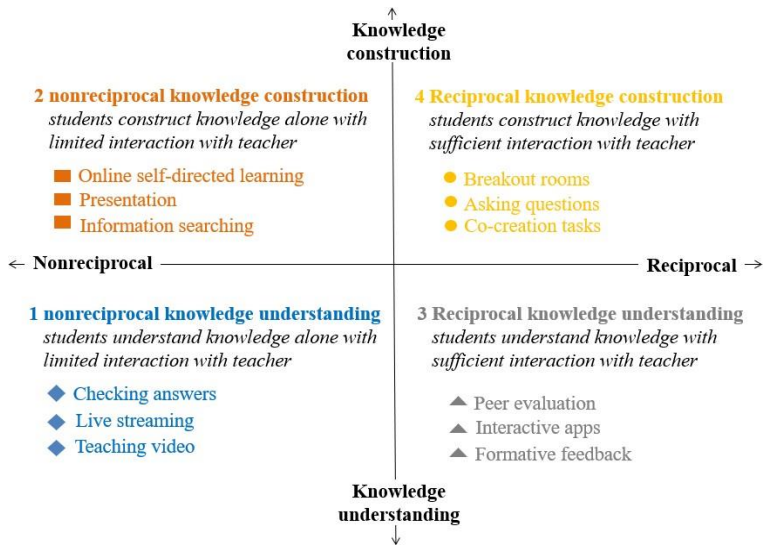


Figure 2. Quadrant Diagram of Four Emergent Online Teaching Orientations.

As shown in Figure 2, 3RKU (reciprocal knowledge understanding) was featured by highly interactive activities where students understand knowledge with immediate support or feedback from the teacher. As Table 1 shows, teachers adopting 1NRKU used similar amount of synchronistic and mixed delivery types (52.5% versus 45.9%). More than half of their teaching materials were innovative adds-on (55.2%), and their class was under their control (teacher-centered = 60.4%). They assigned many interactive quizzes (75.5%), but they also tried interactive games (15.8%) and discussion (9.2%).

4RKC (reciprocal knowledge construction) was featured by co-creation activities where students constructed knowledge with sufficient guidance from the teacher (see Figure 2). As shown in Table 1, teachers adopting 4RKC used more synchronistic and mixed delivery types (69.4% versus 25%). They incorporated many innovative adds-on materials (88.9%) and designed similar amount of teacher-centered and student-centered activities (46.6% versus 53.4%). In their class, interactive quizzes, interactive games, and discussions were commonly seen (37.7%, 26.1%, and 36.2%).

Table 1. *Chi-Square Tests of Percentage Distribution for Measures of Teaching Practices across Four Emergent Online Teaching Orientations*

Emergent online teaching orientations	**1NRKU** *DTA* [a] = 62 Count (%)	**2NRKC** *DTA* = 78 Count (%)	**3RKU** *DTA* = 61 Count (%)	**4RKC** *DTA* = 36 Count (%)	χ^2 *test*
Single response [b]					
Delivery types					$\chi^{22}_{(6,237)} = 35.26$***
Synchronistic	40(64.5)	52(66.7)	32(52.5)	25(69.4)	
Asynchronistic	16(25.8)	11(14.1)	1(1.6)	2(5.6)	
Mixed	6(9.7)	15(19.2)	28(45.9)	9(25.0)	
Innovative adds-on	2(3.2)	8(10.3)	32(52.5)	32(88.9)	$\chi^2_{(3,74)} = 40.38$***
Multiple response [b]					
Teaching Processes					$\chi^2_{(6,1590)} = 183.81$***
Teacher-centered	261(90.6)	264(44.9)	264(60.4)	129(46.6)	
Student-centered UF [c]	10(3.5)	116(19.7)	66(15.1)	49(17.7)	
Student-centered CF [d]	17(5.9)	208(35.4)	107(24.5)	99(35.7)	
Interactive activities					$\chi^2_{(6,231)} = 61.17$***
Quizzes	32(97.0)	47(88.7)	57(75.0)	26(37.7)	
Games	1(3.0)	5(9.4)	12(15.8)	18(26.1)	
Discussion	0(0.0)	1(1.9)	7(9.2)	25(36.2)	

Note. ***p < .001. 1NRKU = nonreciprocal knowledge understanding; 2NRKC = nonreciprocal knowledge construction; 3RKU = reciprocal knowledge understanding; and 4RKC = reciprocal knowledge construction. DTA [a] = Daily teaching activities; the number of the daily teaching activities that belong to a particular emergent online teaching orientation. 48 teachers report 237 daily teaching activities for five days (with missing). Single response [b]: Participants chose one option among choices. Multiple response b: Participants chose more than one option among choices. UF [c] = Understanding-focused. CF [d] = Construction-focused.

4.1 RQ2: Did teachers applying different emergent online teaching orientations report significant differences in subjective teaching quality and online teaching readiness?

The means and standard deviation of subjective teaching quality (i.e., daily optimal experience, daily teaching satisfaction, and daily perceived student engagement) and online teaching readiness (i.e., online professional development and distance teaching TPCK) according to emergent online teaching orientations are summarized in Figure 3. This figure also displays the results of one-way ANOVA that compares the effects of emergent online teaching orientations on subjective teaching quality and online teaching readiness.

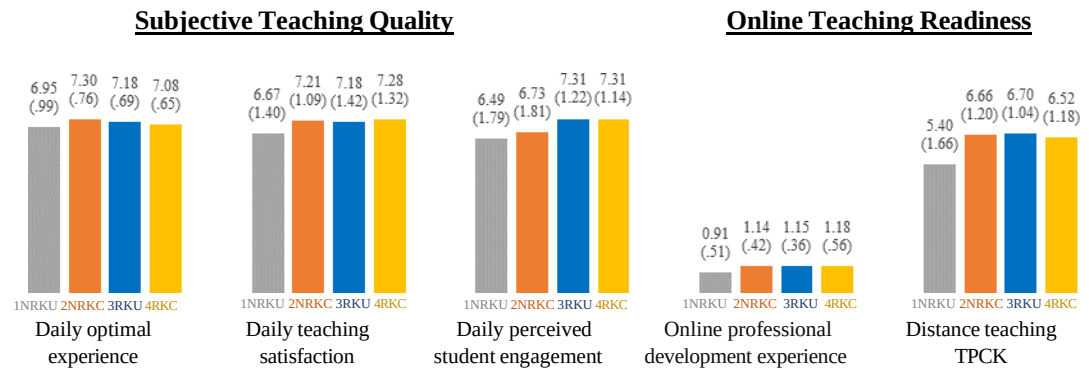
As shown in Figure 3, among the four emergent online teaching orientations, no significant difference was found in daily optimal experience ($F_{(3,232)} = 2.36$, $p = .072$). On the contrary, there was a statistically significant difference in daily teaching satisfaction ($F_{(3,232)} = 2.65$, $p = .05$, $\eta_p^2 = .03$).

According to Fisher's Least Significant Difference Test for multiple comparisons, in terms of the mean value of daily teaching satisfaction, 1NRKU was significantly lower than 2NRKC (p = .017, 95% *C.I.* = [-.97, -.10]), 3RKU (p = .032, 95% *C.I.* = [-.97, -.05]), and 4RKC (p = .027, 95% *C.I.* = [-1.14, -.07]).

Statistically significant difference was also found in daily perceived student engagement ($F_{(3,232)}$ = 3.82, p = .011, η_p^2 = .05). Results of Fisher's Least Significant Difference Test for multiple comparisons showed 1NRKU was significantly lower than 3RKU (p = .005, 95% *C.I.* = [-1.38, -.26]), and 4RKC (p = .015, 95% *C.I.* = [-1.47, -.16]). Besides, 2NRKU was significantly lower than 3RKU (p = .033, 95% *C.I.* = [-1.11, -.05]).

Another statistically significant difference was revealed in online professional development experience ($F_{(3,232)}$ = 4.41, p = .005, η_p^2 = .05). Post-hoc analyses using Fisher's Least Significant Difference Test for multiple comparisons indicated that the mean value of 1NRKU was significantly lower than 2NRKC (p = .003, 95% *C.I.* = [-.39, -.08]), 3RKU (p = .004, 95% *C.I.* = [-.40, -.08]), and 4RKC (p = .005, 95% *C.I.* = [-.46, -.08]).

The final statistically significant difference was found in distance teaching TPCK ($F_{(3,232)}$ = 13.97, p < .001, η_p^2 = .15). Reported by Post-hoc test of Fisher's Least Significant Difference Test for multiple comparisons, the mean value of 1NRKU was significantly lower than 2NRKC (p < .001, 95% *C.I.* = [-1.69, -.82]), 3RKU (p < .001, 95% *C.I.* = [-1.76, -.83]), and 4RKC (p < .001, 95% *C.I.* = [-1.66, -.59]).



Items	$F_{(3, 232)}$	Post-Hoc Test
Subjective teaching quality		
Daily optimal experience	*2.36*	-
Daily teaching satisfaction	*2.65*$^{\#}$	2NRKC, 3RKU, 4RKC > 1NRKU
Daily perceived student engageme	*3.82**	3RKU, 4RKC > 1NRKU; 3RKU > 2NRKC
Online teaching readiness		
Online professional development experience	*4.41***	2NRKC, 3RKU, 4RKC > 1NRKU
Distance teaching TPCK	*13.97****	2NRKC, 3RKU, 4RKC > 1NRKU

Figure 3. ANOVA Examinations on Differences of Subjective Teaching Quality and Online Teaching Readiness across Four Emergent Online Teaching Orientations.

Note. ***p < .001, **p < .01, *p < .05, $^{\#}p$ = .05. 1NRKU = nonreciprocal knowledge understanding (N = 61); 2NRKC = nonreciprocal knowledge construction (N = 78); 3RKU = reciprocal knowledge understanding (N = 61); 4RKC = reciprocal knowledge construction (N = 36).

5. Discussion and Conclusion

The most notable contribution of the present study is to identify four emergent online teaching orientations (Figure 2) and to examine whether significant differences existed among the four orientations in terms of subjective teaching quality and online teaching readiness. When schools were suddenly closed during the COVID-19 pandemic, teachers inevitably experienced anxiety and psychological stress (Chou & Chou, 2021; Kupers et al., 2022). Under pressure, teachers probably

could not focus on interpersonal interaction and knowledge construction at the same time. As long as teachers do not apply 1NRKU, they would feel satisfied with their emergency remote teaching. However, if they intend to increase their satisfaction of perceived student engagement, they should address social presence, as teachers applying 3RKU and 4RKC were found to have significantly higher perceived student engagement than those using 1NRKU and 2NRKC. The emphasis on social interaction has been well documented in previous studies (Martin & Bolliger, 2018; Muir et al., 2019). Based on the findings of the present study, 3RKU was proposed as an effective emergent online teaching orientation to achieve teaching satisfaction and perceived student engagement. Teachers still dominate the classroom to impart knowledge, but interactivity is emphasized through innovative adds-on, interactive games, and discussion.

Two implications can be drawn from this study. Theoretically, this study directly examined teachers' flow/optimal experience, which adds to the empirical findings on flow theory (Csikszentmihalyi, 1990). Future studies could compare teachers' flow/optimal experience across different types of episodes. In practice, teachers are encouraged to engage in sustained professional learning networks (Hsiao & Lin, 2022) in which they can develop their distance teaching TPCK and adapt their ongoing learning so that they can acquire and refine their competence in designing various learning activities in the virtual classroom.

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