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Crisis as Opportunity to Try Something New: Student-Centered Pedagogy During the Onset of COVID-19

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Abstract: The onset of the COVID-19 pandemic in the Spring of 2020 forced a sudden and unexpected disruption of the usual modes of schooling around the world. In the United States, lack of federal, state and district leadership left most teachers to negotiate the chaotic early months of the pandemic on their own. This study attempted to discover to what extent some US teachers used this crisis as an opportunity to jettison traditional teaching methods in favor of more engaging, student-centered practices, and examined whether teacher self-efficacy and facility with technology were related to that decision. Analysis of survey data from PK-12 teachers (n=178) found a near-universal reduction in use of student-centered teaching methods (SCMs) during the onset of COVID-19, especially among teachers who reported higher self-efficacy before the crisis (age and experience were insulating factors). On average, greater self-confidence before COVID-19 was associated with a greater *decrease* in the use of SCMs during the crisis. While TSE during the crisis was positively correlated with use of student-centered methods, the direction of the influence between those two variables could not be determined. In our analysis, the data seem to better support the theory that use of SCMs builds a sense of efficacy, rather than the traditional understanding that it is high TSE that empowers a teacher to use innovative pedagogy, but more study is needed to strengthen that theory. Technology versatility was correlated weakly with TSE in the COVID Onset Period, but we found no evidence of any correlation between technology versatility and SCM usage. The authors recommend further exploration through surveying a wider population and adding data sources beyond teacher self-reports.

Keywords: Pedagogy, Student-centered Methods, COVID-19, Teacher Self-efficacy

1. Introduction

Teachers often find it difficult, even under ordinary circumstances, to implement student centered, active-learning practices in their classrooms, despite the wealth of evidence for how these practices engage students and promote deeper learning. The onset of the Coronavirus pandemic created the most extraordinary circumstances most teachers had ever faced. What, if anything, made it possible for some teachers to turn this crisis into an opportunity?

The highly variegated and localized nature of public education in the United States by itself provides an obstacle to any sort of unified, consistent response to a major crisis. This fragmentation was exacerbated by the federal government's active neglect of preparation for COVID-19, leaving individual schools, teachers, students and families with no time, training or direction to support the sudden shift from in-person to online learning [1, 2].

In April of 2020 three teachers interviewed for the author's podcast described how the pandemic was pushing them to use more creative, student-centered methods.

"Student choice is so important right now," said one. "[Students] are not going to [do work] if they don't want to do it, and they have so many other pressures right now…incorporating choice and student directed activities [is] essential." Another seized on the flexibility of the moment to "make learning more interesting – being a little bit more creative. [It was] an opportunity to broaden the way we teach and to try and engage more children." (Ref deleted).

How typical were these teachers? Any initiatives US teachers took during the first few months of the pandemic were likely to be of their own invention, as very few teachers nationwide perceived clear, consistent directives from their school leadership during that time [4]. By September, many districts were able to organize institutional responses, but until then, most teachers operated in an environment that was "chaotic and uneven" [5] ….and therefore also largely free from mandated curricula, administrative directives and testing pressures that often "mitigate against" efforts to employ more engaging and cognitively demanding teaching methods [6]. To be sure, the pandemic itself provided plenty of other constraints, but what was it about some teachers that they were able to use this time to find new and creative ways of reaching students?

The interviewees' apparent sense of self-confidence led us to pursue this question through the lens of teacher self-efficacy (TSE), an educator's "judgment of [their] capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" [7]. Since there is a dearth of research, at least domestically, into the relationship between TSE and the use of student-centered methods, this study provided an opportunity to explore that question in a unique and dramatic environment. Since a key element of this new environment was online/remote learning, we also examined how teacher facility with technology may have played in this equation.[1]

1.1. Goals of the Study

This study used teacher self-report data to explore the following research questions:

1. To what extent did teachers increase or decrease their use of student-centered methods (SCMs) during March-June 2020, relative to how much they had used such methods earlier in the year?
2. How did teachers' sense of self-efficacy (TSE) during March-June 2020 compare with earlier in the year?
3. What was the nature of the association, if any, between TSE and use of SCMs during this period?
4. What roles, if any, did teacher facility with technology play in either use of SCMs or TSE during this period?

1.2. Review of the Literature

Student-Centered Methods (SCMs)

"Student-centered methods" describe teaching strategies that attempt to "mov[e] students from passive receivers of information to active participants in their own discovery process" [9], including inquiry teaching and learning, cooperative learning and project-based learning [10]. All draw upon a Constructivist approach [11, 12], which positions students in the role as co-facilitators of their own education. These ideas are neither new nor obscure; rather, "these approaches are widely acclaimed and can be found in any pedagogical methods textbook" [13]. There is strong support in the literature for the positive effect of various SCMs on student engagement and motivation [14, 15], and academic achievement [16–18].

Even though "teachers know about [SCMs] and believe they're effective, yet…most instructional time is composed of seatwork and whole-class instruction led by the teacher" [13]. This may be because SCMs are more challenging to implement [19], that traditional school structures create barriers to implementation [20, 6], or that both teachers and students simply more accustomed teacher-centered instruction [21]. Another reason may be that although teacher-directed methods often "do not foster deep learning," such methods do "train students to mimic learning on [standardized] tests" [22] of the kind states use to evaluate schools [23], leading teachers to eschew SCMs [24, 25, 18].

However, once the COVID-19 crisis began, all 50 states received waivers to suspend high-stakes accountability testing [26], and many schools even dispensed with letter grades in classes [27]. Without such "sticks" to motivate students, we wondered if the need for "carrots" motivated teachers to use more SCMs, since students often perceive them to be more enjoyable than traditional ones [28].

Teacher Self-Efficacy (TSE)

Mehta & Fine's definition of TSE builds [7] on research from RAND [29], rooted in the social-cognitive theories of Albert Bandura [30], and posits that a teacher's beliefs about their effectiveness exist in a dialectical relationship with the conditions around them; how they perceive their impact can act as a self-fulfilling prophecy or feedback loop [31]. TSE is seen as important because it represents one of the "few consistent relationships between characteristics of teachers and the behavior or learning of students" [32]. Evidence "suggests that TSE shows positive links with students' academic adjustment, patterns of teacher…practices related to classroom quality, and…teachers' psychological well-being" [33].

Although TSE is understood to be to some extent situational [33], research has examined demographic factors' effects across contexts. Gender, years of teaching experience, and grade level taught have been determined to be predictive factors [34, 35]. Male teachers generally have higher levels of self-efficacy than females, particularly regarding classroom management. Years of teaching experience has a significant curvilinear association with self-efficacy, which is low but increasing in the early part of one's career, then declining in later stages [35]. Teachers of younger children generally have higher levels of self-efficacy than teachers of older ones [35]. Most research about race's effect on TSE focuses on the way it might shape the concept of self-efficacy, as opposed to whether and how teachers' racial/cultural identification affects their TSE according to dominant measures [36].

Teacher Self-Efficacy and Student-Centered Methods

[1] This was another reason, besides the issue of teacher autonomy, for focusing exclusively on Spring 2020. During this period, nearly all schools in the United States were operating exclusively by remote learning, making for an easier basis for comparison. As of September 2020, the landscape had already become more variegated, with approximately 60% of K-12 students still fully remote, 20% fully in person, and 20% in some sort of hybrid mode [8].

Research on connections between teacher self-efficacy and SCMs has been sparse, at least in the United States. Some studies suggest that "teacher efficacy [i]s a strong determinant of teachers' willingness to adopt new practices" in general [37, 38], but the bulk of research about TSE's relationship specifically to SCMs comes from foreign scholarship. One study (n=2,139) found that "teachers with a higher sense of efficacy would tend to adopt Constructivist instruction more frequently" [37]. Other international research found that the TSE of otherwise-highly-confident professors lessened when adopting SCMs (e.g., [39, 40]). Achurraa & Villardón conclude that "the success of [student-centered] teaching activities and practices depends to a great extent on teachers' self perception and confidence…to face up to the changes involved in learner-centered models" [39] SCM usage may be more tied to TSE for humanities/language teachers than for science teachers [41].

Some research challenges the traditional notion of "treat[ing] teacher self-efficacy only as a determinant of…instructional methods," and provides empirical evidence that "it is also possible for instructional practice to affect teacher self-efficacy" [42]. Since student-student and student-teacher communication is so integral to many SCMs, then this added communication "can increase teachers' self-efficacy by providing direct confirmation of how effective they are as teachers." By that same token, Cawtho and Dawson found that students' negative reactions to SCMs, particularly in secondary school settings, can erode TSE and prompt their teachers to use more traditional methods that students "take more seriously." [43]

SCMs and TSE in the Context of Online/Remote Learning

The pandemic presented the particular challenge of remote/online teaching, or "instruction delivered on a digital device that is intended to support learning" [44]. In theory, online/remote learning lends itself well to SCMs because the role of the instructor is comparatively diminished [45]: "[F]rom a pedagogical perspective, a teacher-centered online classroom is an oxymoron in that it removes the need for the [instructor]…The student is forming a relationship with the [content], not with the individual [instructor]." A meta-analysis of 74 studies found the presence of student interaction, when "meaningfully integrated," improves learning outcomes [46]; further studies found that online/remote learning is particularly effective for facilitating student-student and student-teacher collaboration [47, 48], in helping teachers to personalize instruction [49], and in helping students to self-regulate learning [50].

These effects are only realized, however, when "instead of using technology to present information to students, teachers [instead] provide them with opportunities to do projects…collect information, and work with peers" [51-53]. Too often, teachers often use online/remote technologies simply as a means to deliver or enhance traditional, teacher-centered pedagogy [54, 55]. Even as recently as 2017, a RAND study found "technology is still not used symbiotically in the teaching environment" [56].

Research consistently finds that teacher preparation programs fail to sufficiently prepare new teachers with necessary technology skills [57-59], and that assumed traditional, limited applications. Prior to March 2020, online learning had never been implemented on anything close to the scale that the pandemic suddenly demanded. Hodges, et al reminds us that "well-planned online learning experiences are meaningfully different from courses offered online in response to a crisis or disaster." [60] Once the pandemic began, it was unsurprising that the majority of teachers felt insufficiently prepared to transition to online instruction [4].

1.3. Terminology

COVID Onset Period – This refers to the period (March – June 2020) during which US schools ceased normal operations and converted to remote/distance learning.

Pre-COVID School Year – This refers to the time period from the beginning of the 2019-2020 school year until the beginning of the COVID Onset Period.

2. Methodology

2.1. Questionnaire

We constructed a 51-item self-administered survey questionnaire, which we sent out via email in June 2020 to approximately 32,000 individuals who had graduated from [*Redacted*]'s Graduate School of Education or its undergraduate education program between 1970 and 2015, who had email addresses in the alumni database. [*Redacted*] was chosen because the principal investigator's status as core faculty there facilitated access to this data.

We received 222 responses; 44 exited the survey, as instructed, because they were not currently active classroom teachers or because their school had not shifted to remote learning. This study focuses on the remaining respondents (n=178).

We designed the survey to gather:

1) Demographic data
2) Self-reported data regarding
   a) tools and methods of teaching respondents employed both in the Pre-Covid School Year and in the COVID Onset period.
   b) their versatility with technology use
   c) how effective they judged their teaching to be in both periods[2]

The survey integrated modified versions of two existing, validity-tested instruments: the Teachers' Sense of Efficacy Scale [7] and the Student-Centered Teaching Methodology Typology [3], along with additional questions of our own design. The combined survey instrument was administered for feedback and revision to nine graduate students working with the primary investigator.

[2] Additional questions were included regarding topics such as perceived administrative support, concern about students, and awareness of race-based inequities, but the data from these questions was not found to be relevant for this study.

The Teachers' Sense of Efficacy (TSE) scale was created in 1998 and revised in 2001 by Tschannen-Moran and Woolfolk Hoy, synthesizing various studies of efficacy conducted by the RAND organization. It assesses TSE via instructional practices, classroom management, and student engagement, and is generally regarded as "superior to previous measures of teacher efficacy in that it has a unified and stable factor structure" [61]. Both its 24- and 12-item variations "have reported satisfactory reliability and construct validity evidence…across grades and several countries" [33]. We employed the 24-item variation, minus the seven questions that pertained to classroom management, since managing classroom behavior is generally not an aspect of online teaching.

We then paired the TSE instrument with the Student-Centered Teaching Methodologies Inventory (SCTMI), created by Nurenberg and Siegel. The SCTMI is a survey that presents 25 separate teaching methods/practices, using specific terminology employed in Nurenberg's teacher preparation courses that would be familiar to the alumni surveyed. It divides those methods into two categories: Twenty student centered methods and five "traditional" methods. In the SCTMI's pilot study, the SCA (Student Centered Average), calculated by averaging scores on all 20 SCM items, had a high internal reliability, with a Chronbach's alpha of 0.894 [3].

In our current study, we modified the SCTMI to ask respondents not how often they used these methods, but instead whether they used each of these methods more often, less often, or with about the same frequency before and after COVID-19. We decided that using a Likert scale would offer a false sense of quantification; with inter-rater reliability a near impossibility, we used a simple scale of -1 to 1 to indicate whether there was a decrease, an increase, or a maintenance of a respondent's usual frequency of using that method.

Teachers' versatility with technology was estimated by using an index comprised of a sum of frequency scores for use of 22 different commonly-used remote learning technologies including Zoom, Google Classroom, Kahoot, Quizlet, etc. Frequency scores on each technology ranged from 0 to 4, with a score of zero indicating that a teacher had never used the technology, one indicating that the teacher had used the technology once or twice, two indicating occasional use, three indicating regular use, and four indicating that the teacher used the technology "almost all the time or all the time." The index of all 22 technologies thus had a potential range of 0 to 88.

2.2. Limitations of Data

All data was derived from teacher self-reports, which, because they depend on the respondents' accurate assessment of their teaching methodologies, are prone to salience bias and other biases. However, Koziol and Burns' survey of the research found that "teachers can be accurate reporters about their instructional practice" [62], although that accuracy was greatest when the reports center on specific procedures and/or specific time periods (see also [63]), as is the case with this study. Nevertheless, future studies would benefit from employing additional measures.

A limitation of the "change in SCM index" is that a teacher who rarely used SCMs in the Pre-COVID Academic Year and never used SCMs during the COVID Onset Period would receive the same score as teachers who frequently used SCMs in the Pre-COVID Academic Year, and sometimes (but only slightly less frequently) used SCMs during the COVID Onset Period. Since this study only measures *change in the use of SCMs related to the onset of COVID-19* (rather than measuring SCM usage in absolute terms), both teachers would record the same score indicating that their use of SCMs had decreased, even though one teacher might still use SCMs with some frequency while the other never uses them.

We also recognize that a score indicating frequency and variety of technology use is an imperfect proxy for comfort and skill with technology, but a reasonable one, given that frequency of use of technology has been found to be a mediating factor for classroom technology integration [64], as has hands-on experience with various technologies [65].

3. Analysis of the Data

3.1. Sample Demographics

The demographic statistics indicate that the survey sample is similar to, but not completely representative of, the national teaching force [66]. In addition, related to the fact that we surveyed graduates of an education program that certifies teachers to teach in the Commonwealth of Massachusetts, 58% of our sample consisted of Massachusetts teachers. Thus, individuals in our sample were, on average, more likely to be female, less likely to be teachers of color, more likely to work in Massachusetts, and had more years of teaching experience than the national average for teachers. All of this limits the generalizability of our findings for the national scale; however, sample demographics were more similar to the Massachusetts public school teaching force [67, 68]. Although these figures may have shifted to a more experienced teaching population in the past eight years, more experienced teachers are likely still overrepresented in our survey sample, even when compared with the Massachusetts teaching force.[3]

3.2. Student-Centered Methods

Research Question#1: Did teachers increase their use of SCMs during the approximately four-month period of remote learning forced by COVID-19 (March-June 2020), relative to how much they had used such methods for the previous part of SY 2019-2020?

[3] [*Redacted*] University was unable to provide us with the data that we needed to determine to what degree our study population was or was not representative of all [*Redacted*] graduates who fit the criteria for inclusion.

Table 1. *Variables and descriptive statistics.*

Respondent demographics			
Variable	Options/ Scoring		
Gender	Demog. Gender	|Freq.	Percent
	Male	|13	8.39
	Female	|140	90.32
	Prefer not to answer	|2	1.29
Race	Demog. Race	|Freq.	Percent
	Asian/ Pacific Islander |3	1.94	
	Multiracial	|2	1.29
	Black/ African American |7	4.52	
	Hispanic/ Latino	|4	2.58
	Native/ Indigenous Am	|1	0.65
	Prefer not to answer	|7	4.52
	White	|131	84.52
Age	Demog. Age	|Freq.	Percent
	21-30 years	|14	8.97
	31-40 years	|22	14.10
	41-50 years	|46	29.49
	>50 years	|74	47.44
Geographical setting	Geographical setting	|Freq.	Percent
	Rural	|17	9.60
	Suburban	|98	55.37
	Urban	|53	29.94
	Other	|9	5.08
Type of school	Type of school	|Freq.	Percent
	Charter	|4	2.22
	Pilot/ magnet	|1	0.56
	Religious private	|13	7.22
	Secular private	|22	12.22
	Traditional public	|135	75.00
	Other	|5	2.78
Years teaching experience	Length of teaching	|Freq.	Percent
	Less than 5 years	|23	12.71
	5-10 years	|25	13.81
	11-20 years	|50	27.62
	More than 20 years	|83	45.86
Grade level taught	Grade level taught	|Freq.	Percent
	PreK	|37	16.52
	Elementary	|76	33.93
	Middle	|39	17.41
	High	|40	17.86
	Post-Secondary	|7	3.12
	Adult Education	|4	1.79
Subject taught			
Student-Centered Methods			
See specific items and scores in Table 2, below			
Student-Centered Methods index (SCM1)		-0.247 (range -1 to 1)	0.352
Teacher Self Efficacy			
TSE indices[4] (1-9 scale)	Internal reliability Eigenvalue: 8.28	Mean indexed score	Standard deviation
Efficacy in Pre-Covid School Year	Chronbach's alpha: 0.93 Factor loadings range from 0.51 to 0.78 Eigenvalue: 9.65	8.15 (range 1-9)	0.743
Efficacy during COVID Onset Period	Chronbach's alpha: 0.96 Factor loadings range from 0.64 to 0.82	5.06 (range 1-9)	1.776
Difference in efficacy, Pre-COVID minus COVID Onset period		-3.08	1.805
Use of technology			
How often did you use the following technologies?	Twenty-two specific tools listed including Google Classroom, ClassDojo, Kahoot, Quizlet, etc.		Scoring: 0: Didn't use it 1: Used it occasionally 2: Used it regularly 3: Used it all/ almost all of the time

[4] Results for each of the 17 individual TSE instrument survey items omitted for space

Respondent demographics			
Use of technology index	Sum of scores of 22 separate tools Range of possible scores: 0-66 Range of scores in dataset: 1-37	Mean technology versatility index: 18.07	Standard deviation: 6.06

Table 2. *Teachers' use of SCMs before March-June 2020 vs. during March-June 2020.*

Student-Centered Method	**% who used SCM less often after vs. before COVID-19**	**% who used SCM the same amount after vs. before COVID-19**	**% who used SCM more often after vs. before COVID-19**	**Average indexed score (scale -1 to 1)**
Assignments that apply to real-world situations	24.8%	55.4%	19.8%	-0.051
Assignments designed to cater to students' interests	15.4%	60.9%	23.7%	0.083
Assignments that connect to students' personal lives	18.0%	61.5%	20.5%	0.026
Assignments ask students engage in self-reflection/ self-evaluation	33.1%	49.3%	17.6%	-0.155
Assignments that focus on socio-emotional learning	27.8%	53.0%	19.2%	-0.086
Assignments designed to be culturally relevant	23.2%	69.5%	7.3%	-0.159
Full class discussions	76.4%	18.6%	5.0%	-0.714
Small group discussions	69.1%	22.3%	8.6%	-0.604
Meetings for check-in/ community-building, not for academic purpose	33.3%	30.6%	36.1%	0.028
Conferencing with students	50.7%	23.6%	25.7%	-0.250
*Flexible deadlines for assignments**	*5.3%*	*27.3%*	*67.4%*	*0.621*
Having students work in cooperative groups	59.5%	10.1%	30.4%	-0.291
*In-class reading and writing **	*57.5%*	*36.6%*	*6.96%*	*-0.504*
KWL charts	41.9%	13.1%	45.0%	0.031
Project based learning	50.0%	37.7%	12.3%	-0.377
Service learning	75.8%	20.0%	4.2%	-0.716
Simulations/ roleplaying exercises	82.6%	16.3%	1.1%	-0.815
Socratic circles	80.0%	18.0%	2.0%	-0.780
Student choice in what assignments to pursue	35.9%	38.3%	25.8%	-0.101
Students peer edit one another's work	86.9%	11.9%	1.2%	-0.857
Students play a role in creating teaching resources	77.0%	18.9%	4.1%	-0.730
Students teach classmates or younger students	84.2%	13.2%	2.6%	-0.816
Think pair share exercises	52.9%	5.7%	41.4%	-0.115
Average indexed score	51.7%	29.8%	18.6%	-0.247

* Item not included in SCM index, but considered to be of interest.

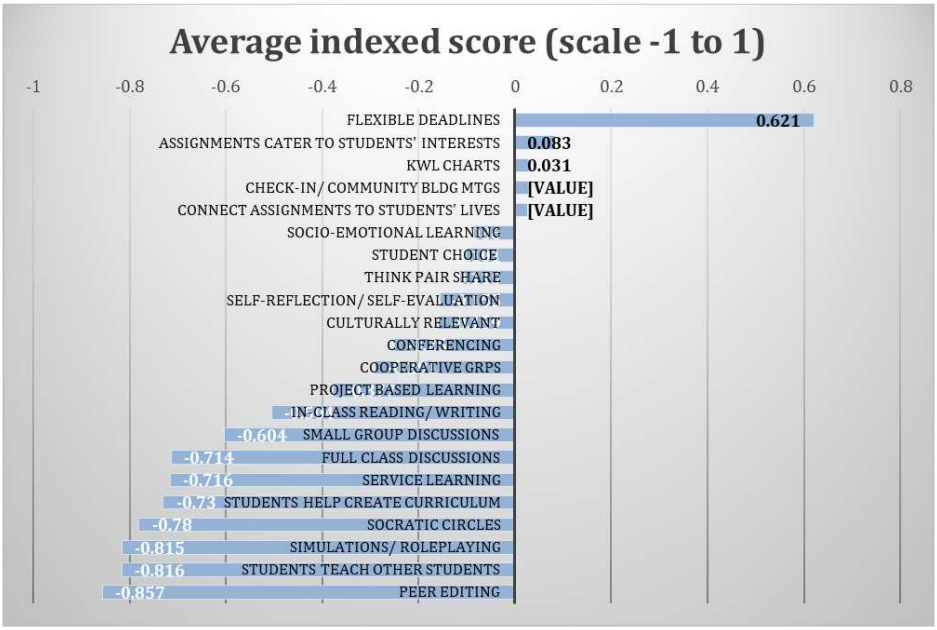

Figure 1. *Teachers' use of specific SCMs before March-June 2020 vs. March-June 2020.*

On the average teachers in the study reported using fewer SCMs as a whole during the COVID Onset Period. As noted in Table 1, the indexed score for change in use of SCMs from the Pre-COVID Academic Year to the Onset Period was -0.247 on a scale from -1 to 1. A score of -1 would indicate that all respondents reported using all SCMs less frequently

during the COVID Onset Period than before. A score of 0 would indicate no change, on average, in use of SCMs during the Onset Period. A score of 1 would indicate that all respondents reported using all SCMs more frequently during the Onset Period than in the Pre-COVID Academic Year. Thus, the average indexed score of -0.247 indicates that, on average, respondents reported using SCMs less frequently during the COVID Onset Period.

Specific SCMs saw more dramatic reductions than others, as visualized in Figure 1.

While a modestly greater proportion of teachers increased, rather than decreased, their use of assignments designed to connect with students' interests and lives, and their holding of check-in meetings, these greater increases were close to zero, and their standard deviations far exceeded the magnitude of the scores. Flexible deadlines, while not technically an SCM as defined by the instrument, nevertheless could be considered a method of involving student input and self-assessment into scheduling, and is notable for its comparatively large increase in the COVID Onset Period.

Any significant relationships we found between demographic factors and use of SCMs in our study were nonsignificant or marginally significant, and thus are not reported here.

Research Question #2: How was teachers' sense of self-efficacy during March-June 2020 compare with the self-efficacy they felt for the previous part of the 2019-2020 school year?

It was hypothesized the onset of the pandemic would be correlated with a reduction in TSE. As predicted, teachers' sense of efficacy dropped, on average, by 3.08 points on a 9-point scale (with a standard deviation of 1.81) when teachers were asked retrospectively to rate their efficacy in 17 dimensions during the Pre-COVID Academic Year vs. the COVID Onset Period. Overall, there was a wider variation in TSE after the COVID Onset period (standard deviation=1.78) than in Pre-COVID Academic Year (standard deviation=0.74).

We examined several demographic factors as well other crisis-related factors like concern for students' health, administrative support, and awareness of racial and socioeconomic inequities, and found several variables to have significant correlations with change in TSE between the Pre-COVID Academic Year and the COVID Onset Period (including, as predicted by the literature, gender and grade level). However, with the exception of teaching PreK, none of the variables that predicted TSE were found to separately predict change in use of SCMs, so they are not discussed here.

We do, however, want to highlight that as a part of this analysis, multivariate OLS regressions were performed using known correlates of TSE on both TSE during the COVID Onset Period and on the difference between TSE estimates before/ after this period. Known correlates of TSE during the COVID Onset Period or of difference in TSE before/ after this period, including (as relevant to this paper) technology versatility, were tested in various regression models. Although some regression coefficients were not statistically significant in a multivariate regression (e.g. PreK grade level in the TSE in the COVID Onset Period regression, suburban geographic location, technology versatility in the before/ after regression, and feeling of administrative support), removing these independent variables resulted in lower R^2 values; thus they were retained in the final models, which maximized coefficient significance and adjusted R^2 values. See Table 3.

Table 3. *Multivariate OLS regressions, TSE during the COVID Onset Period and TSE Difference before vs. during this period.*

TSE during COVID Coef./std. errors	**TSE difference before vs. during COVID Coef./std.errors**	
PreK	-0.52	-0.94**
	(0.40)	(0.40)
Teach 5-10 yrs	-0.84*	-0.80*
	(0.43)	(0.44)
SUBURBAN	0.45	0.26
	(0.32)	(0.33)
PUBLIC	-1.13***	-0.97**
	(0.37)	(0.38)
Tech versatility	0.05*	0.04
	(0.03)	(0.03)
Concerned students -0.62**	-0.66**	
will fall behind	(0.26)	(0.27)
Feel admin suppt	0.07	0.04
	(0.06)	(0.06)
Perceive racial	0.14**	0.16***
Inequities	(0.06)	(0.06)
_cons	5.65***	-2.15**
(1.01)	(1.03)	
No. of Obs.	103.00	103.00
R-Squared	0.30	0.30
** p<0.05*	*** p<0.01*	**** p<0.001*

In summary, holding all else equal in a multivariate regression, teachers' feelings of self-efficacy during the COVID Onset Period were positively correlated with technology comfort versatility.

Research Question#3. What was the nature of the relationship, if any, between TSE and use of SCMs during this time period?

Use of SCMs were examined in relation to teacher self-efficacy. Teachers' scores on the SCM index were weakly *negatively correlated* with TSE in the Pre-COVID Academic Year (r=-0.16). This indicates that teachers who reported high levels of TSE in the Pre-COVID Academic Year had, on average, a greater decrease in the range of SCMs that they tried during the COVID Onset Period.

In contrast, teachers' scores on the SCM index were *positively* correlated to TSE during the COVID Onset Period (r=0.25). Greater use of SCMs were correlated with a *lesser* drop in TSE between the Pre-COVID Academic Year and the COVID Onset periods (r=0.31). This indicates that teachers who were able to maintain a relatively high level of efficacy during the remote learning period were also more likely to maintain or increase use of SCMs.

Several regression models were tested to explore the associations between change in use of SCMs, TSE during the COVID Onset Period, and change in TSE from the Pre-COVID Academic Year to the COVID Onset Period.

As predicted, TSE during the COVID Onset Period was associated with a lesser drop in use of SCMs. A lesser drop in in TSE from before to during the COVID Onset Period was correlated with a lesser drop in use of SCMs from the Pre-COVID Academic Year to the COVID Onset Period.

Although technology versatility was not a significant predictor of change in the use of SCMs (see next research question), it was retained because its inclusion in the regression model resulted in higher R^2 values. Technology versatility was found to be correlated with length of teaching career.

The results displayed in Table 4, below, indicate that TSE and SCMs have some similar predictors (i.e., teaching Pre-K), while other predictors are not significantly associated with indices. TSE during the COVID Onset Period and difference in TSE between the Pre-COVID Academic Year and the COVID Onset Period, however, are significantly associated with SCMs, indicating that there is an independent relationship between use of SCMs and teacher self-efficacy in the COVID Onset Period.

Table 4. *Multivariate OLS regressions, change in use of SCMs vs. TSE in COVID Onset Period and TSE Difference.*

Use of SCMs vs. TSE after Coef./std.~s	**Use of SCMS vs. TSE difference Coef./std.~s**	
TSE during COVID Onset Period	0.06***	
	(0.02)	
Teach 10-20 yrs	-0.16*	-0.16*
	(0.07)	(0.07)
Tech versatility	-0.00	-0.00
	(0.01)	(0.00)
Teach Pre-K	0.16*	0.21**
	(0.07)	(0.07)
TSE Difference Pre-COVID *v* COVID Onset Period	0.08***	
	(0.02)	
_cons	-0.53***	0.05
	(0.13)	(0.12)
No. of Obs.	105.00	105.00
Adj R-Squared	0.14	0.22
** p<0.05*	*** p<0.01*	**** p<0.001*

As noted above, these results do not allow us to make any causal inferences about the direction of the relationship between SCM and TSE.

Research question#4. What roles, if any, did teacher facility with technology play in either use of SCMs or TSE during this period?

The mean indexed score for teacher responses to the technology portion of the survey was 18.08 and the actual range was 1-37, with mean indexed scores for all teachers following a roughly normal curve and middle 50 percent of scores falling between 15-22.

As predicted, versatility with online technologies was positively correlated (albeit weakly) with TSE after the beginning of the COVID Onset Period (r=0.19) as well as with difference in perceived TSE during vs. before the COVID Onset Period (r=0.19). Thus, individuals with higher scores on the technology versatility index had higher levels of TSE, and lesser drops in perceived efficacy, during the COVID Onset Period. However, the overall difference in use of SCMs before and after the onset of the crisis was not correlated with mean indexed technology versatility scores.

4. Discussion

By the standards of the data in our survey population, the teacher interviewees from the podcast who reported greater use of SCMs in response to the COVID-19 crisis were outliers. Across all sample groups in the study, SCM usage on average plummeted during the COVID Onset Period.

How did self-efficacy relate? Change in SCM usage was found to be correlated with TSE after the onset of COVID-19, although the direction of the influence between the two variables could not be conclusively determined. However, on average, greater self-confidence before COVID-19 was associated with a greater *decrease* in the use of SCMs during the crisis. That is, a baseline level of confidence did *not* propel teachers into using more SCMs during the

COVID onset period. Although this result does not contradict the possibility that teachers with higher TSE may have used SCMs to a greater degree before COVID, it runs contrary to the hypothesis that high baseline levels of TSE gave teachers the confidence to maintain using SCMs during the crisis. This unexpected finding lends support to an alternative theory: that the *positive* association between change in SCM usage and TSE *during* the COVID onset period may be attributed to teachers' heightened sense of success and efficacy as a result of experimenting with SCMs.

What about technology versatility? The finding that technology versatility was correlated (weakly) with TSE in the COVID Onset Period lent support to our hypothesis that TSE during this period was at least partially dependent on comfort with online technology. However, we found no evidence of any correlation between technology versatility and SCM usage.

Since many, though not all, of the SCMs we tested for involved students working in groups, a remote learning environment may have represented a big hurdle. However, Zoom and other remote learning platforms did offer "breakout rooms" and other tools for facilitating group-based activities; whether the majority of the teachers in the study were unaware of these methods, were aware but underconfident in using them, or found them inadequate to the task was something we were not able to discover, but would be useful to know in terms of informing best practices in online learning.

5. Conclusions

Despite their apparent outlier status, the teachers interviewed in the author's podcast who saw the COVID-19 crisis as a call to use more SCMs may be on to something. The positive attitudes they expressed may well be a *result* of their increased experimentation with SCMs. While the cross-sectional dataset used in this study could not be used to determine a causal relationship, as discussed earlier, the data seem to better support the theory that use of SCMs builds a sense of efficacy, rather than the traditional understanding that it is high TSE that empowers a teacher to use innovative pedagogy. Perhaps it is only in a crisis of sufficient magnitude that this traditional understanding is upended; possibly, only in such cases can trying something challenging and ambitious become energizing and motivational, instead of just intimidating.

The pandemic continued to cast a shadow over US schools for the 2021-22 academic year, with some schools continuing remote or hybrid learning during periods of that time. Further study is needed on how teachers' self-efficacy, and use of student centered methods, were affected by these more sustained conditions. Research into what methods best engage students is always important; times of upheaval like the last 18 months are when effective teaching methods become crucial, as is the hope that the very act of innovation can indeed empower us.

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