Empowering Teacher Learning and Teacher Self-Efficacy

Estimating the Impacts of a Self-Directed Learning Intervention in a Randomized Trial Using OLS

Applied Econometrics Final Project
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Empowering
Teacher
Learning
Appalachian State University

Seeking Effective Innovations in Education

The Problem:
The Department of Education recognizes the importance of education on the health and well-being of individuals in our society, as well as the impact of an educated population on state and national economies.

What We Know:
- Traditional teacher professional development models have little impact on teachers' instructional practices (Artman et al., 2020)
- Improved teacher self-efficacy can improve student learning (De Smul et al., 2018)

What We Want to Know:
- Can a new, specific form of teacher PD improve teacher self-efficacy?

Empowering Teacher Learning

The Empowering Teacher Learning Project is a 5-year, $12M research experiment funded by the Department of Education to study the impacts of self-directed professional learning. Teachers are given choice and guidance as they earn licensure renewal credits (CEUs) by completing teacher-selected, online, competency-based micro-credentials.

Middle Schools in Western NC
Rural, high-need districts

Appalachian State University
Teacher microcredential support, teacher stipends, and research

NC Department of Public Instruction
Replace CEU currency from time-based to competency-based

Digital Promise
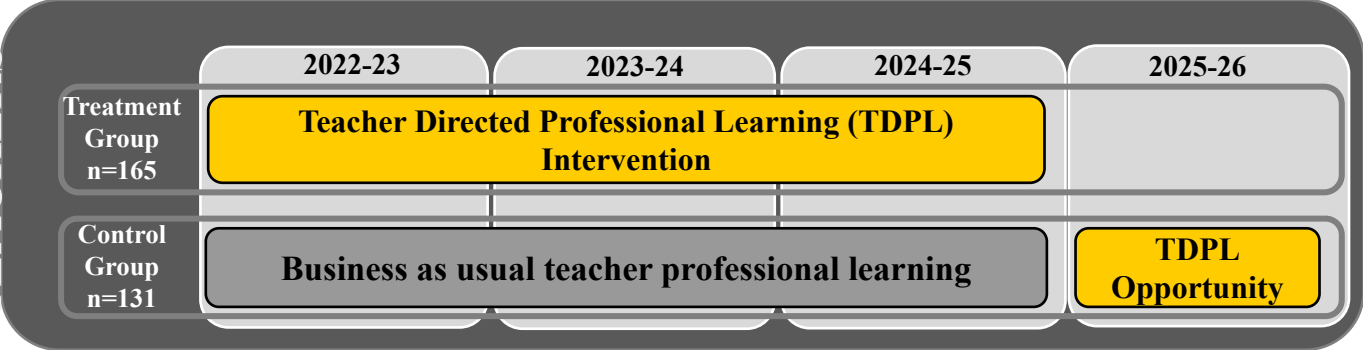Highly-vetted, online Microcredential Platform

The Experiment

	Total % (n) (Total N = 296)	Treatment % (n) (Total N = 165)	Control % (n) (Total N = 131)
0-5 Years	44% (n=129)	42% (n=69)	46% (n=60)
6-10 Years	20% (n=58)	19% (n=32)	20% (n=26)
11-19 Years	21% (n=62)	22% (n=36)	20% (n=26)
>20 Years	16% (n=47)	17% (n=28)	15% (n=19)

Table 1. Years of Teaching Experience by Treatment and Control Groups

Research Timeline

	2022-23	2023-24	2024-25	2025-26
Treatment Group n=165	Teacher Directed Professional Learning (TDPL) Intervention			
Control Group n=131	Business as usual teacher professional learning			TDPL Opportunity

Variables

- **TSESComposite** - measure of teacher self-efficacy

- **Treatment** - binary (0=control, 1=treatment)
- **TSESComposite_B** - baseline measure of teacher self-efficacy
- **FederalEthnicity**
- **Gender**
- **LevelofEducation**
- **YearsMiddleSchool**
- **GradesServedCat**
- **SubjectAreaCat**
- **block** - school categories measured by low/high turnover and low/high achievement

Data

ID	Outcome	Time	Treatment	Baseline
1	Y_{t1}	1	1	Y_{t0}
1	Y_{t2}	2	1	Y_{t0}
2	Y_{t1}	1	0	Y_{t0}
2	Y_{t2}	2	0	Y_{t0}
3	Y_{t1}	1	1	Y_{t0}
4	Y_{t1}	1	0	Y_{t0}
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

Figure 1. Basic Data Structure (excluding covariates)

Baseline Comparison

Ordinary Least Squares with Blocking

$$TSESComposite\_B = \beta_0 + \beta_1 Treatment + block$$

β_1 represents the estimated impact of the intervention on baseline self-efficacy relative to the control group

Null Hypothesis: *Average baseline scores for treatment and control groups are the same*

Baseline Comparison

With a p-value of 0.413, we fail to reject the null hypothesis and baseline equivalence is confirmed.

```
. reg TSESComposite_B Treatment i.block
```

Source	SS	df	MS			
Model	12.6996486	4	3.17491215	Number of obs	=	487
Residual	372.68316	482	.773201577	F(4, 482)	=	4.11
				Prob > F	=	0.0028
				R-squared	=	0.0330
				Adj R-squared	=	0.0249
Total	385.382809	486	.792968743	Root MSE	=	.87932

TSESCompos~B	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
Treatment	-.0669642	.0816949	-0.82	0.413	-.2274863	.0935579
block						
2	.0155026	.1160133	0.13	0.894	-.2124517	.243457
3	.2691028	.1088016	2.47	0.014	.0553188	.4828868
4	.4310075	.1410234	3.06	0.002	.1539109	.7081042
_cons	6.701084	.1024792	65.39	0.000	6.499723	6.902445

Figure 2. Baseline Treatment Estimate

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Analysis

Ordinary Least Squares with Blocking, Controlling for Covariates

$TSESComposite = \beta_0 + \beta_1 Treatment + \beta_2 TSESComposite\_B + [Other\ Controls] + block$

β_1 *represents the estimated average growth in treatment group scores, relative to the control group*

Hypothesis 1: *After 1 year of intervention, the average growth in treatment group scores is equal to the growth in control group scores*

Hypothesis 2: *After 2 years of intervention, the average growth in treatment group scores is equal to the growth in control group scores*

Results


```
. reg TSESComposite Treatment TSESComposite_B i.FederalEthnicity Gender i.LevelofEducatio
> n YearsMiddleSchool i.GradesServedCat i.SubjectAreaCat i.block if Year == 1
```

Source	SS	df	MS			
				Number of obs	=	294
				F(26, 267)	=	8.93
Model	103.862385	26	3.99470712	Prob > F	=	0.0000
Residual	119.449702	267	.447377163	R-squared	=	0.4651
				Adj R-squared	=	0.4130
Total	223.312088	293	.762157295	Root MSE	=	.66886

TSESComposite	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
Treatment	.1936585	.0845966	2.29	0.023	.0270973	.3602197
TSESComposite_B	.6416527	.0465309	13.79	0.000	.5500386	.7332669
FederalEthnicity						
2	-.2590954	.3584623	-0.72	0.470	-.9648676	.4466769
3	.1774145	.6016311	0.29	0.768	-1.00713	1.361959
Gender	.2695313	.1066819	2.53	0.012	.0594864	.4795761
LevelofEducation						
4	-.1389508	.0895286	-1.55	0.122	-.3152226	.0373211
5	-.3075921	.2551875	-1.21	0.229	-.8100278	.1948436
6	.3411612	.6933059	0.49	0.623	-1.023881	1.706203
YearsMiddleSchool	-.001109	.0051843	-0.21	0.831	-.0113162	.0090982

Figure 3. Impact on TSES after 1 year

Results


```
. reg TSESComposite Treatment TSESComposite_B i.FederalEthnicity Gender i.LevelofEducatio
> n YearsMiddleSchool i.GradesServedCat i.SubjectAreaCat i.block if Year == 2
```

Source	SS	df	MS			
				Number of obs	=	192
				F(24, 167)	=	5.75
Model	72.5741033	24	3.02392097	Prob > F	=	0.0000
Residual	87.7515673	167	.525458487	R-squared	=	0.4527
				Adj R-squared	=	0.3740
Total	160.325671	191	.839401416	Root MSE	=	.72489

TSESComposite	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
Treatment	.1652365	.1144366	1.44	0.151	-.0606923	.3911654
TSESComposite_B	.6061996	.0619865	9.78	0.000	.4838215	.7285778
FederalEthnicity						
2	.3118202	.4021654	0.78	0.439	-.4821632	1.105804
3	.1715958	.6667656	0.26	0.797	-1.14478	1.487972
Gender	.2620604	.1449372	1.81	0.072	-.024085	.5482058
LevelofEducation						
4	.1626762	.1223499	1.33	0.185	-.0788757	.4042282
5	.0562069	.4072201	0.14	0.890	-.747756	.8601698
YearsMiddleSchool	.0014377	.0071307	0.20	0.840	-.0126403	.0155156

Figure 4. Impact on TSES after 2 years

Findings and Conclusions

After 1 year of intervention, the treatment group scores increased, on average, 0.194 points more than those of the control group. With a p-value of 0.023, there is sufficient evidence to warrant rejection of the first null hypothesis.

After 2 years of intervention, the average growth in treatment group scores was insignificant compared against that of the control group, with a p-value of 0.151. Thus, we fail to reject the second null hypothesis.

One year of ETL intervention is shown to be an effective way to generate a statistically significant increase in teacher self-efficacy, which may have positive implications on teaching and learning.

Conversely, a 2nd year of intervention appears to be unnecessary, or even detrimental, to increasing teacher self-efficacy.

Refinement and Further Study

Why do the results revert after the second year?
- May indicate the need to refine the second year intervention
- Possibly due to an issue with sample size or statistical power
- Possibly due to the limits of using Likert-scale instruments

What could be improved?
- In the year-2 analysis, we should be controlling for the year-1 growth.
- We should also be accounting for clustering that influenced the randomization process
- Instead of OLS, we need a longitudinal, mixed model (HLM) analysis of covariance (ANCOVA)
- Need to standardize the impact estimation (Hedge's g) and compare it against a minimum detectable effect size

Further Study
- A third and final year of intervention is ongoing
- Full analysis, including reliability test and correlation analysis of TSES subfactors

Questions?

Thank you!

Citations

Artman, Bryan, Natalie Danner, and Sherry R. Crow. "Teacher-directed professional development: An alternative to conventional professional development." *International Journal of Self-Directed Learning 17*.1 (2020): 39-50.

De Smul, M., Heirweg, S., Van Keer, H., Devos, G., & Vandevelde, S. (2018). How competent do teachers feel instructing self-regulated learning strategies? Development and validation of the teacher self-efficacy scale to implement self-regulated learning. *Teaching & Teacher Education, 71,* 214–225. https://doi-org.proxy006.nclive.org/10.1016/j.tate.2018.01.001