Report 2013-02

Indiana Science Initiative Update: Teacher's Science Teaching Efficacy Beliefs

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The I-STEM vision is for Indiana to be a national leader in student achievement and to demonstratively improve college and career readiness in the STEM disciplines.

Background

Change in science teaching efficacy belief was assessed for the Indiana Science Initiative (ISI) teacher participants before the summer training in 2011 and again at the end of the 2011-2012 school year. For this assessment, teacher efficacy is understood as a type of self-efficacy where teachers construct beliefs about their ability to perform at a certain level of attainment (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). This conception includes effort, persistence, and resiliency to failure and is consistent with Bandura's constructs which suggest that people are motivated to perform an action if they believe the action will have a favorable result (outcome expectation), and they are confident that they can perform that action successfully (self-efficacy expectation) (Bleicher, 2004). Teacher efficacy can be context and subject-matter specific. Teachers may feel more or less competent when faced with specific subject matter, different age levels, or teaching in a certain environments (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998).

For the evaluation of the ISI teacher professional development, teacher efficacy was examined with the Science Teaching Efficacy Belief Instrument (STEBI). STEBI was developed by Enochs and Riggs' (1990). The STEBI identifies two separate factors, personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE).

Improvement in teacher efficacy can have important implications. Studies have indicated that the use of effective and innovative instructional strategies promoted by national standards is related to the teachers' content specific efficacy beliefs about teaching and knowledge about the national standards themselves (Haney and Lumpe, 1995; Borko and Putnam, 1995; Haney, Czerniak, & Lumpe, 1996 as cited in Enochs, Smith, & Huinker, 2000). Researches have also suggested that a teacher's sense of efficacy has been related to student outcomes such as achievement (Allinder, 1995) and motivation (Midgley, Feldlaufer, & Ecceles, 1988). In addition, teachers with a strong sense of efficacy tend to exhibit greater levels of planning and organization (Allinder, 1994), are more open to new ideas (Guskey, 1988), and are more willing to experiment with new methods to better meet the needs of their students (Stein & Wang, 1988 as cited in Akinsola, 2008).

Analysis and Results

698 teachers participating in the ISI 2011 summer professional development took the STEBI pre-survey and 148 of these teachers took the STEBI post-survey. Pre-surveys were given on-line before teacher summer professional development and post-surveys were given near the completion of the 2011-2012 school year. The difference in number of pre- and post-surveys is due to some teacher participants not taking the online STEBI a second time. All 698 teachers will be requested to take another STEBI at the end of the 2012-2013 school year. A paired, one-tailed, f-test was done to find statistically significant changes in the science teaching efficacy beliefs of the participating teachers as indicated on the pre- and post-surveys. Changes were examined for individual survey items (see Appendix A for results), the PSTE, and the STOE.

Because a paired f-test was done, some surveys were not able to be used for the assessment. Only pre- and post-surveys that could be matched to a participating teacher could be used and any surveys with incomplete items were excluded for either the item analysis or the overall analysis. This left 147 complete paired surveys as the maximum number for the item analysis and PSTE and STOE analysis. The analysis of the PSTE showed a statistically significant increase in the teachers personal science teaching efficacy ($p<.01$). However, the analysis for the STOE showed a statistically significant decrease ($p<.01$) in this category. In other words teachers are more confident about their ability to teach science but don't believe it will impact their student learning. This is a very unusual occurrence as that we believe may be environmental. During the time between the pre- and post- STEBI there was substantial discussion, and implementation, of new rules for teacher evaluation that put more weight on student outcomes. The counter argument to this was that there were many other factors, beyond the classroom environment/teacher that impacted student learning. While we don't know this to be the cause it seems probable. The 698 teachers from pre-STEBI will be asked to take it again to see if the decline in the STOE continues or remained consistent. If it does, follow-up surveys will be conducted to investigate the cause(s) of the decline.

Individual items that demonstrated a statistically significant positive change are listed below. These questions represent a significant shift towards strongly agreeing with the statement except for questions with three asterisks (***). The asterisks identify negatively worded items so a statistically significant change represents a change toward strongly disagreeing with the statement. For the individual item analysis, the following items showed a statistically significant increase ($p < .05$):

- Even when I try very hard, I don't teach science as well as I do most subjects***
- I know the necessary steps to teach science effectively
- I am not very effective at monitoring science experiments***
- I generally teach science ineffectively***
- I find it difficult to explain to students why science experiments work***
- I am typically able to answer students science questions
- I wonder if I have the necessary skills to teach science***
- When a student has difficulty understanding a science concept, I am usually at a loss to help the student understand better***

The following items showed a statistically significant decrease ($p < .05$)

- When science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.
- If students are underachieving in science, it is most likely due to ineffective science teaching.
- The inadequacy of student's science background can be overcome by good teaching.
- Increased effort in science teaching produces little change in some students' science achievement***
- Effectiveness in science teaching has little influence on the achievement of students with low motivation***
- Even teachers with good science teaching abilities cannot help some kids learn science***
- Students' achievement in science is directly related to their teacher's effectiveness in science teaching.

- If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.

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Appendix A

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	1_1	3.73	177	.869	.065
	2_1	3.75	177	.871	.065
Pair 2	1_2	4.09	177	.748	.056
	2_2	4.11	177	.706	.053
Pair 3	1_3	3.32	177	1.034	.078
	2_3	3.49	177	1.018	.076
Pair 4	1_4	3.84	177	.620	.047
	2_4	3.64	177	.757	.057
Pair 5	1_5	3.70	177	.743	.056
	2_5	3.98	177	.719	.054
Pair 6	1_6	3.68	177	.918	.069
	2_6	3.82	177	.845	.063
Pair 7	1_7	3.25	177	.843	.063
	2_7	2.86	177	.950	.071
Pair 8	1_8	3.95	177	.778	.058
	2_8	4.14	177	.710	.053
Pair 9	1_9	3.86	177	.669	.050
	2_9	3.68	177	.848	.064
Pair 10	1_10	2.79	177	.890	.067
	2_10	2.72	177	.940	.071
Pair 11	1_11	3.66	177	.689	.052
	2_11	3.55	177	.745	.056
Pair 12	1_12	4.03	177	.698	.052
	2_12	4.10	177	.762	.057
Pair 13	1_13	3.63	177	.802	.060
	2_13	3.45	177	.935	.070
Pair 14	1_14	3.54	177	.683	.051
	2_14	3.46	177	.746	.056
Pair 15	1_15	3.50	177	.762	.057
	2_15	3.33	177	.857	.064
Pair 16	1_16	3.61	177	.631	.047
	2_16	3.44	177	.789	.059
Pair 17	1_17	3.83	177	.719	.054
	2_17	3.97	177	.703	.053
Pair 18	1_18	3.94	177	.637	.048
	2_18	4.10	177	.512	.038
Pair 19	1_19	3.84	177	.871	.065
	2_19	4.02	177	.882	.066
Pair 20	1_20	3.75	177	.727	.055
	2_20	3.52	177	.833	.063
Pair 21	1_21	3.86	177	.938	.070
	2_21	3.94	177	.915	.069
Pair 22	1_22	3.93	177	.696	.052
	2_22	4.01	177	.554	.042
Pair 23	1_23	4.41	177	.660	.050
	2_23	4.47	177	.534	.040
Pair 24	1_24	4.02	177	.707	.053
	2_24	4.05	177	.624	.047
Pair 25	1_25	3.42	177	.957	.072
	2_25	3.12	177	1.037	.078
Pair 26	PSTE_PRE	50.6158	177	6.75373	.50764
	PSTE_Post	52.2203	177	6.08482	.45736
Pair 27	STOE_Pre	42.5876	177	5.07495	.38146
	STOE_Post	40.5311	177	6.33716	.47633

Appendix A

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	1_1 - 2_1	-.017	.962	.072	-.160	.126	-.234	176	.815
Pair 2	1_2 - 2_2	-.023	.885	.067	-.154	.109	-.340	176	.735
Pair 3	1_3 - 2_3	-.175	.976	.073	-.320	-.030	-2.388	176	.018
Pair 4	1_4 - 2_4	.203	.835	.063	.080	.327	3.241	176	.001
Pair 5	1_5 - 2_5	-.282	.753	.057	-.394	-.171	-4.989	176	.000
Pair 6	1_6 - 2_6	-.141	1.059	.080	-.298	.016	-1.774	176	.078
Pair 7	1_7 - 2_7	.384	.988	.074	.238	.531	5.172	176	.000
Pair 8	1_8 - 2_8	-.186	.757	.057	-.299	-.074	-3.277	176	.001
Pair 9	1_9 - 2_9	.186	.835	.063	.063	.310	2.969	176	.003
Pair 10	1_10 - 2_10	.068	1.069	.080	-.091	.226	.844	176	.400
Pair 11	1_11 - 2_11	.107	.794	.060	-.010	.225	1.799	176	.074
Pair 12	1_12 - 2_12	-.068	.933	.070	-.206	.071	-.967	176	.335
Pair 13	1_13 - 2_13	.181	.983	.074	.035	.327	2.446	176	.015
Pair 14	1_14 - 2_14	.073	.754	.057	-.038	.185	1.296	176	.197
Pair 15	1_15 - 2_15	.169	.914	.069	.034	.305	2.468	176	.015
Pair 16	1_16 - 2_16	.175	.845	.063	.050	.300	2.759	176	.006
Pair 17	1_17 - 2_17	-.141	.697	.052	-.245	-.038	-2.697	176	.008
Pair 18	1_18 - 2_18	-.158	.610	.046	-.249	-.068	-3.448	176	.001
Pair 19	1_19 - 2_19	-.175	.928	.070	-.313	-.037	-2.511	176	.013
Pair 20	1_20 - 2_20	.232	1.065	.080	.074	.390	2.895	176	.004
Pair 21	1_21 - 2_21	-.079	.920	.069	-.216	.057	-1.144	176	.254
Pair 22	1_22 - 2_22	-.079	.626	.047	-.172	.014	-1.682	176	.094
Pair 23	1_23 - 2_23	-.068	.609	.046	-.158	.022	-1.482	176	.140
Pair 24	1_24 - 2_24	-.028	.749	.056	-.139	.083	-.501	176	.617
Pair 25	1_25 - 2_25	.294	1.030	.077	.141	.447	3.795	176	.000
Pair 26	PSTE_PRE - PSTE_Post	-1.60452	4.93153	.37068	-2.33606	-.87298	-4.329	176	.000
Pair 27	STOE_Pre - STOE_Post	2.05650	5.25348	.39488	1.27720	2.83580	5.208	176	.000

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