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The Relationship Between U.S. High School Science Teacher's Self-Efficacy, Professional Development, and Use of Technology in Classrooms

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Abstract: There have been a limited number studies that examined the relationship between professional development (PD) and self-efficacy with technology tool use, specifically concerning high school science teachers. The main goal of this quantitative study was to identify any specific correlations between science teacher self-efficacy and the professional development science teachers received for those specific classroom technologies. Participants were comprised of a randomized sample set of high school science teachers throughout 46 different US States.The data was collected by using an online survey via the Qualtrics survey platform. The survey was sent to 3000 science instructors and 104 in total completed it. The results suggest that science teachers' efficacy was high with course management systems and student wireless or digital devices, but not for social networking/media. There was no significant connection between technological self-efficacy and PD for related technology tools. However, it is possible that science teachers are already highly efficacious in terms of technology, and observational studies are recommended to see when and how teachers actually use technology in their classrooms.

Keywords: *professional development; relationship; science teacher's; self-efficacy; technology tools.*

Theoretical Framework

Social cognitive theory was our main focal point and framework for the study, as it emphasizes both internal and external influences on teachers' classroom behavior (Bandura, 1997). The social cognitive theory states that learning is an act of obtaining knowledge through various cognitive processes and explains the relationship between a person, their environment, and their behavior, as well as taking on an agent-like view towards change. The social cognitive framework is made up of various unique areas of learning and reflection for the individual: self-evaluation, self-observation, self-efficacy, and self-reaction (Bandura, 1997). Social cognitive theory can be used to determine what makes teachers show high levels of self-efficacy, as well as what leads to a lack of belief that they can complete a specific classroom task.

This current study measured teachers' self-efficacy through a self-reporting style questionnaire. The survey involved a broad range of questions comprising high school science educators' thoughts about their competencies in performance when teaching with technology.

Introduction

Teacher self-efficacy is described as a teacher's own ability to achieve specific goals of student engagement when teaching (Tschannen- Moran & Woolfolk-Hoy, 2001). An educator's self-efficacy refers to their self-beliefs in their ability to deal with, arrange, and execute certain activities that are necessary to achieve their specific teaching goals (Bandura, 2004). Teacher self-efficacy is different from teacher "competence," which is usually applied to refer to teachers' professional knowledge and teaching skills (Gavora,

2010). Since self-efficacy focuses on the capability of one to achieve specific goals it can be considered situationally appropriate self-confidence. Bandura (2004) links high levels of self-reported self-confidence to envisioned self-efficacy that is assumed to connect to low risk tasks. Self-efficacy plays a vital role in improving employee motivation, thus reinforcing the idea that external forces are not the only drivers in decision-making. There are four areas of material which are used to asses efficacy: past experiences, verbal persuasion, indirect experiences, and physiological feedback. These aspects assist individuals in establishing whether they have the capability to complete a particular job (Bandura,1997). Past experiences are the vital foundation of self-efficacy. Both desirable and undesirable experiences can impact the aptitude of people to complete a specific task. If someone has previously completed a job well, he or she is more likely to feel capable of doing a related task.The second source is verbal persuasion. This source of self-efficacy is affected through positive and negative reinforcement regarding a person's ability or aptitude to do. The third source of self-efficacy includes indirect experiences. Individuals could experience low or high self-efficacy while learning under others' instruction. An individual could view someone in a like role and then compare his or her own skill with the other person's ability (Bandura, 1997).

The last source focuses on physiological feedback. In this instance, people receive various stimuli from their brains, and their observations of these stimuli and emotional arousal, influences their beliefs of efficacy (Bandura, 1997). Though this fact has the least impact of the four, it is essential to realize that if an individual feels at ease with a task at hand, they will feel more accomplished and have increased feelings of self-efficacy (Bandura, 2005). Holden &Rada (2011) have noted that teacher confidence of using technology in schools, and high educator self-efficacy leads to higher technology use. In this study, the focus is on (a) self-efficacy of teacher's performance, (b) accomplishment in their abilities to achieve specific goals in their classrooms regarding technology use, and (c) the professional development teachers have had in technology use.

Literature Review

The literature review of this paper provides an overview of prior researches that did conduct on educators' self-efficacy and professional development in using technology tools in the classroom.

Siebert (2006) found that teacher self-efficacy is essential for educators so that they can achieve their classroom goals, but teachers' self-efficacy, abilities, and skills are not the same thing. In 2009, Skaalvik and Skaalvik revealed that instructors with high levels of self-efficacy would more probably have increased levels of job satisfaction, and educators with low self-efficacy were more susceptible to experiencing stress. Low teacher-efficacy was also reported to impact the extent to which teachers felt prepared to choose and use supporting educational technologies used for learning and instruction (Moore-Hayes, 2011).

McCormick and Ayers (2009) found that when teachers believe in their educational methods, they perform better as instructors. In addition, teachers who had higher efficacy were more likely able to curate environments which were conducive to an impactful learning experience (Swan, Cano, & Wolf, 2011). Instructors with high levels of teaching efficacy have also been found to have increased motivation and drive

to do well in their profession (Tschannen-Moran, Hoy & Hoy, 2001). These studies indicate that teacher self-efficacy does affect general classroom performance. However, there have been no studies that specifically studied high school science teacher performance and science educators' self-efficacy with their use of technology-based teaching tools in their classrooms.

Therefore, it is essential to consider how a teacher's self-efficacy is constructed in the first place, as well as ways to continually increase teacher self-efficacy for high school science teachers. Another problem that should be addressed is why teachers lack self-efficacy when implementing teaching methods and managing a classroom. Sawn, Wolf, and Cano (2011) studied how different variances of self -efficacy in teaching changed between student teaching to the third year of teaching. However, they included only 34 teachers teaching at Ohio State University, and participants were solely limited to those in agricultural education, creating a very narrow field of study. Therefore, there is a need for studies that are more generalizable across teachers and classrooms.

Self-efficacy could potentially become increasingly vital versus skills and awareness for instructors who utilize technology in their daily classroom use. In 2009, Koh and Frick discovered a positive correlation between educators computer self-efficacy and the percent of technology tool use levels in their classrooms.If teachers were educated to apply technology prior to beginning their teaching careers, their self-efficacy increased, as well as their potential to use technology in their schools (Ertmer & Leftwich, 2010). Comparable studies show that when educators find it rewarding to utilize computers for classroom instruction, there is an increased probability that they will increase their use of technology (Marwan, 2008). Overall, it has been found that there is a true correlation between educator's self-efficacy and their quality of technology combination in the classroom. More study needs to be done to fully understand student-focused outcomes to determine if better use of technology results in better student learning.

Limited studies have looked into the influence of professional development and its impacts on teacher self-efficacy. Improving teacher self-efficacy, though, is crucial because research findings suggest that educators who have higher self-efficacy levels are more open to using their abilities and plans from professional development in their classrooms (Bray-Clark & Bates, 2003). In 2003, Clark and Bates raised the question of whether self-efficacy can provide schools and staff technology specialists with the tools they need to craft impactful teacher training, raise educator abilities, and extend and improve student learning outcomes.

We trust that self-efficacy, when utilized as a changing motivator in the design of teacher training and professional development, can give a sound framework for understanding the whys and hows of instructor development. Self-efficacy directs back to the perceived but not yet fully actualized set of realistic tools including feedback, various instructional style elements, and integrated support systems that can be used to increase positive efficacy beliefs, better teacher abilities, and enhance student learning. Additional research is needed to truly realize the amount of professional experiences that would serve to expand educator self-efficacy in teaching with technology tools in the classroom.

In 2006, Watson examined 389 K-12 math and science instructors with internet use in their classrooms.

Watson (2006) compared the teachers' self-efficacy levels in using the Internet to teach their curriculum before and after a professional development intervention. The teachers had to complete a rigorous summer workshop alongside additional online classes. Teachers were surveyed before the workshop with questions on a 5-point Likert scale, and six years later, the teachers were emailed the same survey. It was found that educators had a big increase in their self-efficacy levels when in their classrooms, and were able to retain the benefits of the in-person workshops and online training. The results reveal that (a) integrating high-rigor summer workshops with more online classes increased some aspects of self-efficacy over just having a single professional development workshop, (b) educators' levels of self- efficacy increased after a series of summer workshops, and their self-efficacy also stayed high, even years after their involvement in the program, and (c) certain external factors actually do involve educator efficacy over the long term. The study displayed that educator training does have an effect on educator self-efficacy in respect to the use of modern internet-based technology tools at schools (Watson, 2006).

Powell-Moman and Brown-Schild (2011) looked to see if there was a correlation between a long-term teaching improvement program and educator self-efficacy. The researchers found that after a two-year professional development program for inquiry-style teaching, a significant increase was observed in teacher self-efficacy levels. Additionally, Overbaugh and Lu (2008) examined 377 K-12 teachers in a federal grant-funded training program.

The research investigated the impact of the training on the participants' self-efficacy levels when learning about and using instructional technology. The professional development model consisted of six weeks of online courses and two weeks of in-person technology training.Quantitative collection measures were utilized both before and after the practices to determine teacher self-efficacy levels, and interviews were conducted to collect qualitative data from training participants. The researchers found that self-efficacy in teachers increased from the start of the study and teachers maintained their self-efficacy levels based on the follow-up surveys and interviews (Overbaugh & Lu, 2008).

Johnson, Adams, Becker, Estrada, and Freeman (2015) suggested that professional development workshops and online training need to be updated to make them both exciting and compelling for today's in-service teachers. Related specifically to technology use, Johnson et al. (2015) found that educators lack training in basic technology teaching techniques. Many teachers choose not to take part in technology training made available to them as educators because they fear that technology could take their jobs, or instructors believe that they will not be able to recognize complex technologies (Johnson et al., 2015). Educators who have implemented technology in their classrooms have taken advantage of professional development which led teachers to understand how technology and their teaching priorities coincide (Penuel, 2006). Yet, even though professional development is improving educators' skills, such as computer use, the integration of technology into the classroom is still limited (Brinkerhoff, 2006).

Professional development training is now available to many educators online, making it easier than ever before to use the ample wireless internet connection to better their craft as teachers (Gray, Thomas, & Lewis, 2010). About 78% of teachers believe that professional

development exercises sufficiently prepared them for technology use in schools (Gray et al., 2010). Overall, professional development alone is not enough and educators are not getting enough professional development in technology use. Educators should be taught with the technology they will be using so they can experience learning through technological tools, and be better prepared to use these tools (Hanover Research, 2014, p.6).

Problems that still need to be investigated comprise training plans and curriculum for instructing teachers how to use technology in their classrooms. In addition, several of these studies were conducted over a decade ago. Clarke and Hollingsworth (2002) focused on higher education in their professional development model, but lacked focus on high school teachers in general. We understand that technology exponentially changes every year, and that makes it hard for the professional development model to stay updated with which tools teachers should be proficient in.

As a result of the current rate of technological change, instructional technology professional development should focus on assisting teachers to develop skills that enable them to continually explore new and unfamiliar tools, instead of concentrating only on specific hardware and software that become outdated quickly. Professional development should also focus on strategies that support student learning and group learning and discussion. Previous studies have mentioned professional development (Clarke & Hollingsworth, 2002; Gray et al., 2010), but did not include evidence on the exact duration of the training or provide a list of the technology tools that teachers were trained in. More research needs to be done to look at the correlation and causation between professional development given to teachers and the self-efficacy that is produced from it. It is important to know what professional development teachers have had involving technology tools in order to help both teachers and administrators better understand how to select tools that fit with their needs and teaching styles.

While the literature focuses on the quality of professional development, there was little research on how the tool type might impact future teacher use. It is known that science, apart from other subjects, is very technology-heavy and with the increase of technology tools used in classrooms, this is a greater area of focus more than ever before. In addition, science teachers were a compelling case because many science teachers may feel more comfortable using non-laboratory technologies because they are already comfortable with technologies from their lab use.

In summary, only limited research has considered the connection between self-efficacy and professional development, but professional development training has been shown to increase self-efficacy in some ways. Professional training and development is a vital tool for raising the self-efficacy of educators. Additional research is needed around teacher self-efficacy to identify professional experiences that improve educator self-efficacy. People who educate teachers and professional development personnel benefit from this research to better retain more effective teachers. There is an opportunity for research to look further into the correlation between prolonged PD on using technology and the self-efficacy of teachers for usingthat technology. For this paper, we are especially interested in the connection between professional development and self-efficacy with the use of three specific technology tools: course management systems, student wireless or digital devices, and social media.

Research Questions

1. What do science teachers believe about their self-efficacy level for using course management systems, student wireless or digital devices, and social networking/media, and does professional development impact that efficacy?
2. What correlational (if any) relationships are there between self-efficacy, professional development, and use of course management systems, student wireless or digital devices, and social networking/media in the classroom?

Survey Development

We needed a survey that combines all three aspects of interest for this research: modern teaching technologies, self-efficacy, and professional development. Therefore, we created our own survey because there was not one. The survey was set up on the Qualtrics platform and was sent to a convenience sample of educators, as part of a pilot study conducted two months prior to the research study. The purpose of this pilot study was to support the survey's content validity. The survey was also sent to other educators for qualitative feedback and further validation. Most survey questions were gathered from previous surveys, especially Yidana's (2007) and Pan and Franklin's (2011).We named the survey:"Professional Development and Self-Efficacy in Using Technology Tools in Classroom."

Cortina(1993) indicated "coefficient alpha is useful for estimating reliability in a particular case when item-specific variance in a unidimensional test is of interest. If a test has a large alpha, then it can be concluded that a large portion of the variance in the test is attributable to general and group factors. This is important because it implies that there is very little item-specific variance." (Cortina, 1993, p.103). Cronbach's alpha coefficient was applied to test the internal consistency of the instruments for this study to determine the consistence and accuracy of the answers (Heale & Twycross, 2015). By using the responses from the convenience sample of teachers (n=36) for an initial reliability estimate, we coded all the answers through SPSS and ran a Cronbach's Alpha (α=0.724). This number suggests that the survey had an acceptable reliability for research use. We did examine the reliability analysis again with the larger sample size of (104). The Cronbach's Alpha was (α=0.811).

Our survey had two parts: the first part covered demographic information such as age, gender, science discipline, level of education, the state teachers teach in, class period duration, class size, school setting, and years of teaching experience. The second part of the survey included a variety of 5-point Likert scale style questions asking about the use of course management systems, student wireless or digital devices, social networking/media, we also did ask about others tools that we did not include in this paper, and their professional development and self-efficacy related to these tools.For each 5-point Likert-scale item, high school science teachers were asked to show the degree to which they disagree or agree with several statements (Strongly Disagree, Disagree, Uncertain, Agree, Strongly Agree). The measures of the 5-point Likert-scale were identified under three categories: low- self-efficacy in the point range of (1.0-1.80 to 1.81-2.60), moderate self-efficacy in the point range of (2.61 – 3.40), and high self-efficacy in the point range of (3.41-4.20 and 4.21-5.00) (Pimentel, 2010).

Data Collection & Analysis

The participants of the research were high school teachers from 46 states. The study had 64 female, 39 male, and one non-binary individual respond. Tables one, two, and three below show the demographic descriptions of the high school teachers for age, level of education, and science subject area taught.

Table1
Description of the High School Teacher Respondents by Age

Age	Frequency	Percentages
Under 25 years	4	3.8
26-35 years	35	33.7
36-45 years	27	26.0
46 and Up	38	36.5
Total	104	100

Table 2
Description of the High School Teacher Respondents by Level of Education

Level of Education	Frequency	Percent
Bachelors	29	27.9
Masters	69	66.3
PhD	4	3.8
Other	2	1.9
Total	104	100.0

Table 3
Description of the High School Teachers Respondents by Science Subjects

Science Discipline	Frequency	Percent
Biology	38	36.5
Chemistry	33	31.7
Physics	18	17.3
Earth science	8	7.7
Engineering	1	1.0
Other	6	5.8
Total	104	100

The first author collected the a list of high schools by state from Wikipedia We chose to use Wikipedia despite its limitations, because it listed all the high schools by state and county, including private, public, and charter schools. These schools were arranged by county and the counties were arranged alphabetically. The researcher copied and pasted all the lists directly from Wikipedia and then put them into Microsoft Word documents. The list was stripped of headings and bullet points and then was numbered. Each state was given its own Word document. A random number generator was used to choose various schools from every state (https://www.random.org, 2018).

For each school that was chosen via their random number, we went to that school's website to get science teachers' emails. Through this process, the researcher was able to acquire 60 emails from each of the 50 states, with a total of 3000 emails. The first 2000 emails were sent to the list of science teachers across

the US with a descriptive email and link to the survey questions via Qualtrics website. However, only 1,970 emails went through since some of those emails were bounced, failed, or were duplicated. Since we did not get enough responses within two weeks (only 45 finished surveys), we resolved to send a reminder email to the teachers. Following the reminder email, we got 21 teachers who completed surveys which were still not enough samples from the second attempt.

We sent out the survey to a new group of 1000 teachers. However, only 486 emails went through since some of those emails were bounced, failed, or were duplicated. From this additional batch of emails, we got 15 teachers who completed surveys. Since we did not get enough responses within one week, we decided to send a reminder email to the teachers, we received 23 completed surveys, which was our final attempt to collect data. This was an anonymous survey and the data was collected automatically and saved online on the Qualtrics website. It took participants 15 minutes or less to fill out the survey which could be done on any computer or device anywhere in the country with access to the internet. Statistical Package for Social Scientists (SPSS) version 24.0 was applied for data analysis to respond to the research questions for this study. For research question one, we considered frequencies and percentages with some descriptive statistics as well as standard deviation, mean, and the level of the mean scores of self-efficacies with professional development and use of the three tools. For research question two, we used Spearman's rank correlation matrix between self-efficacy, professional development, and each of the technology tools.

Results

Course Management Systems

For question one, Table 4 below shows the highest efficacy average was linked to the phrase, "Given a choice, I would choose to teach with a course management system instead of not teaching with a course management system," with a mean of 4.18 out of 5. The small Standard Deviation (0.833) indicates homogeneity of responses around this statement and therefore little dispersion. The 4.18 average is within the interval [3.41 – 4.20], and is therefore considered high efficacy. The statements, "I feel that I have a well-rounded and clear understanding of how to integrate a course management system into my classroom," and "I feel that I can achieve my student learning outcomes when using a course management system in my classroom" both had high means that corresponded to high self-efficacy. A moderate efficacy mean was linked to the phrase, "My experiences in professional development with this tool aided my ability to effectively use it." Overall, the mean Likert scale rating of the four self-efficacy questions was 3.82 out of 5 with a standard deviation 0.742. Hence, science teachers believe that they had an acceptable level of self-efficacy using course management systems in their classroom (Table 4).

Table 4
Science Teachers' Self-efficacy as it Relates to PD and Use of Course Management Systems

	Statement		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	Mean	*SD*	Level
1	Given a choice, I would choose to teach with a course management system instead of not teaching with a course management system.	*N*	0	3	17	36	40	4.18	0.833	High
		%	0	3.1	17.7	37.5	41.7			
2	I feel that I have a well-rounded and clear understanding of how to integrate a course management system into my classroom.	*N*	1	11	13	38	33	3.95	1.019	High
		%	1	11.5	13.5	39.6	34.4			
3	My experiences in professional development with this tool aided my ability to effectively use it.	*N*	11	17	18	39	11	3.23	1.209	Moderate
		%	11.5	17.7	18.7	40.6	11.5			
4	I feel that I can achieve my student learning outcomes when using a course management system in my classroom.	*N*	1	6	15	52	22	3.92	0.854	High
		%	1	6.3	15.6	54.2	22.9			
Mean and Standard Deviation								3.82	0.742	High

For question two, the Spearman's rank correlation matrix indicated statistically significant positive correlations between and across all aspects of self-efficacy, professional development, and course management system use in the classroom (Table 5). The highest correlation coefficient was between, "My experiences in professional development with this tool aided my ability to effectively use it" and hours of professional development ($r = 0.627$; $p < 0.01$).

Student Wireless or Digital Device

For question one, the highest efficacy average was associated with the phrase, "Given a choice, I would choose to teach with student wireless or digital devices instead of not teaching with student wireless or digital devices." The mean was 4.0 and the Standard Deviation was 0.941, that shows an increase of efficacy level, and little dispersion. Only the efficacy phrase, "My experiences in professional development with this tool aided my ability to effectively use it" (mean=2.98) corresponded to a moderate efficacy level. Overall, teachers had high self-efficacy across all the efficacy statements for student wireless or digital devices (mean=3.72; Table 6).The relationships between self-efficacy, professional development, and technology use of student wireless or digital devices in the classroom was determined via a Spearman's rank correlation matrix (Table 7).

Table 5
Relationship Between Self-efficacy, PD, and Use of a Course Management System

	How many hours of professional development training have you had for cms?	How often do you use a cms?	Given a choice, I would choose to teach with a course management system instead of not teaching with a cms.	I feel that I have a well-rounded and clear understanding of how to integrate a cms into my classroom.	My experiences in professional development with this tool aided my ability to effectively use it.	I feel that I can achieve my student learning outcomes when using a cms in my classroom.
How many hours of professional development training have you had for for cms?	1					
How often do you use a cms?	0.247*	1				
Given a choice, I would choose to teach with a course management system instead of not teaching with a cms.	0.254*	0.522**	1			
I feel that I have a well-rounded and clear understanding of how to integrate a cms into my classroom.	0.331**	0.539**	0.511**	1		
My experiences in professional development with this tool aided my ability to effectively use it.	0.627**	0.211*	0.269**	0.315**	1	
I feel that I can achieve my student learning outcomes when using a cms in my classroom.	0.337**	0.428**	0.564**	0.551**	0.509**	1

Note. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

All correlations were positive, but not all were significant. The highest correlation coefficient was between the two efficacy statements, “I feel that I can achieve my student learning outcomes when using student wireless or digital devices in my classroom” and “Given a choice, I would choose to teach with student wireless or digital devices instead of not teaching with a student wireless or digital devices.” The lowest significant correlation was between, hours of PD and frequency of use.

Table 6
Science Teachers' Self-efficacy as it Relates to PD and Use of a Student Wireless or Digital Device

	Statement		Strongly disagree	Disagree	Uncertain	Agree	Strongly disagree	Mean	SD	Level
1	Given a choice, I would choose to teach with a student wireless or digital device instead of not teaching with a student wireless or digital device	N	2	4	15	39	29	4.00	0.941	High
		%	2.2	4.5	16.9	43.8	32.6			
2	I feel that I have a well-rounded and clear understanding of how to integrate a student wireless or digital device into my classroom	N	3	4	10	52	20	3.92	0.907	High
		%	3.4	4.5	11.2	58.4	22.5			
3	My experiences in professional development with this tool aided my ability to effectively use it	N	12	21	20	29	7	2.98	1.196	Moderate
		%	13.5	23.6	22.5	32.6	7.9			
4	I feel that I can achieve my student learning outcomes when using a student wireless or digital device in my classroom	N	2	15	53	19	2	3.98	0.768	High
		%	2.2	16.9	59.6	21.3	2.2			
	Mean and Standard Deviation							3.72	0.666	High

Social Media

For question one, table 8 below shows that the highest efficacy average was linked to the phrase, "I feel that I have a well-rounded and clear understanding of how to integrate social networking/media into my classroom" with a Standard Deviation of 1.161 and a mean of 2.85. This mean indicates just a moderate efficacy level. Teachers had moderate efficacy levels for all self-efficacy statements except for, "My experiences in professional development with this tool aided my ability to effectively use it," which had a low efficacy level (mean=2.31). Overall, teachers had held only moderate efficacy for using social media in the classroom (mean=2.62). For question two, table 9 below shows the Spearman's rank association matrix between the self-efficacy, professional development, and social networking/media use in the classroom. For this tool, there were both negative and positive correlations, but only some of the positive connection were significant. The highest association coefficient was between the two efficacy statements, "I feel that I can achieve my student learning outcomes when using a social networking/media in my classroom" and "I feel that I have a well-rounded and clear understanding of how to integrate a social networking/media into my classroom" ($r = 0.678$). While the lowest correlation coefficient was between efficacy statements, "My experiences in professional development with this tool aided my ability to effectively use it" and "Given a choice, I would choose to teach with a social networking/media instead of not teaching with a social networking/media" ($r = 0.266$).

Table 7
Relationships Between Self-efficacy, PD, and Use of a Student Wireless or Digital Device

	How many hours of professional development training have you had for student wireless or digital devices?	How often do you use a student wireless or digital device?	Given a choice, I would choose to teach with a student wireless or digital device instead of not teaching with a student wireless or digital device.	I feel that I have a well-rounded and clear understanding of how to integrate a student wireless or digital device into my classroom.	My experiences in professional development with this tool aided my ability to effectively use it.	I feel that I can achieve my student learning outcomes when using a student wireless or digital device in my classroom.
How many hours of professional development training have you had for student wireless or digital devices?	1					
How often do you use a student wireless or digital device?	0.389**	1				
Given a choice, I would choose to teach with a student wireless or digital device instead of not teaching with a student wireless or digital device.	0.089	0.459**	1			
I feel that I have a well-rounded and clear understanding of how to integrate a student wireless or digital device into my classroom.	0.145	0.393**	0.405**	1		
My experiences in professional development with this tool aided my ability to effectively use it.	0.608**	0.126	0.097	0.187	1	
I feel that I can achieve my student learning outcomes when using a student wireless or digital device in my classroom.	0.145	0.410**	0.615**	0.537**	0.189	1

Note. **Correlation is significant at the 0.01 level (2-tailed).

Table 8
Science Teachers' Self-efficacy as it Relates to PD and Use of Social Networking/Media

	Statement		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	Mean	SD	Level
1	Given a choice, I would choose to teach with social networking/media instead of not teaching with social networking/media	N	11	14	18	11	1	2.58	1.083	Low
		%	20.0	25.5	32.7	20.0	1.8			
2	I feel that I have a well-rounded and clear understanding of how /to integrate social networking media into my classroom	N	8	14	14	16	3	2.85	1.161	Moderate
		%	14.5	25.5	25.5	29.1	5.5			
3	My experiences in professional development with this tool aided my ability to effectively use it	N	17	15	13	9	1	2.31	1.136	Low
		%	30.9	27.3	23.6	16.4	1.8			
4	I feel that I can achieve my student learning outcomes when using social networking/media in my classroom	N	6	17	20	11	1	2.71	0.975	Moderate
		%	10.9	30.9	36.4	20.0	1.8			
	Mean and Standard Deviation							2.62	0.820	Moderate

Table 9
Relationships Between Self-efficacy, PD, and Use of Social Networking/Media

	How many hours of professional development training have you had for social networking/ media?	How often do you use social networking/ media?	Given a choice, I would choose to teach with social networking/ media instead of not teaching with social networking/ media.	I feel that I have a well-rounded and clear understanding of how to integrate social networking/ media into my classroom.	My experiences in professional development with this tool aided my ability to effectively use it.	I feel that I can achieve my student learning outcomes when using social networking/ media in my classroom.
How many hours of professional development training have you had for social networking/media?	1					
How often do you use social networking/media?	0.048	1				
Given a choice, I would choose to teach with social networking/media instead of not teaching with social networking/media.	0.368**	0.074-	1			
I feel that I have a well-rounded and clear understanding of how to Integrate social networking / media into my classroom.	0.227	0.108	0.483**	1		

Table 9—Continued

	How many hours of professional development training have you had for social networking/ media?	How often do you use social networking/ media?	Given a choice, I would choose to teach with social networking/ media instead of not teaching with social networking/ media.	I feel that I have a well-rounded and clear understanding of how to integrate social networking/ media into my classroom.	My experiences in professional development with this tool aided my ability to effectively use it.	I feel that I can achieve my student learning outcomes when using social networking/ media in my classroom.
My experiences in professional development with this tool aided my ability to effectively use it.	0.577**	0.231-	0.266*	0.139	1	
I feel that I can achieve my student learning outcomes when using social networking/media in my classroom.	0.273*	0.089-	0.609**	0.678**	0.279*	1

Note. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

Discussion

This study investigated the association between high school science educators' professional development and self-efficacy with technology tool use in the following areas: course management systems, student wireless or digital devices, and social media in classrooms. It was discovered through this study that overall, all science teachers in this survey had high levels of self-efficacy with course management systems and student wireless/digital devices, but not for the use of social networking/media. However, in 2002, the National Center for Education Statistics (NCES) noted that less than half of American teachers used computers or the Internet. Because it took place almost two decades ago, though that NCES study is now about well outdated technology tools. Therefore, this research included some more recent technology tools (course/learning management systems, student wireless/digital devices, social networking). This current research is up-to-date with the existing technology teachers are using today.

Today, more than ever before, technology tools are rapidly changing (Bennett, Maton, & Kervin, 2008). These changes make it difficult to study and create repeatedly relevant conclusions. Teachers need to be kept updated with professional development to learn to embrace these technological changes to learn which technologies will expand teacher knowledge-bases and increase their students' learning successes. Not all technologies are necessarily useful for all learning experiences. For example, teachers in this study reported that they had low self-efficacy for the use of social media in their classrooms, but they might use social media in their personal lives with more self-efficacy. Researchers should continue to inspect the efficiency of new technologies in various educational situations. It was found in this study that the way educators specifically chose to educate using technology tools and their perception of how to integrate technology into the classroom both played an integral role in their technology use choices.

Instructors who have carried out technology use in their classrooms have benefitted professional development, which led instructors to understand how technology and their teaching needs coincide (Penuel, 2006). So, we reinforce that professional development is essential for educators' achievement in the classroom. However, professional development demands large amounts of teachers' time and attention to be effective (Killion, 2013). In numerous districts, this time could have to be included in contracts and salaries (Miles, Odden, Fermanich, Archibald, & Gallagher, 2003).

Implications

My study raised awareness that student outcomes were associated with the way educators select to educate using technology tools and the teachers' knowledge of how to integrate technology into the classroom. Since this study investigated the association between high school science educators' professional development and self-efficacy with technology tools use comprising course management systems, student wireless or digital devices, and social media in classrooms with a sample size of 104 educators, the outcomes may facilitate new research for expanding the results to include new and more updated technology tools.

Overall, this is a useful survey that could be used in individual schools or districts to see where their educators are as far as using different technologies in their classrooms. It is easily modifiable to comprise the specific technologies that they are expecting educators to actuallyuse. Additionally, high school science educators are rather efficacious, and that could be because they are science educators or it could be because they responded to an email to take a digital survey. We really could use a more representative sample, administering paper and pencil copies possibly. Yet, professional development does appear to be important and we need to continue further to make an effort toward offering professional development sessions on all kinds of technology, but furthermore, especially anything that a district or school expects teachers to use. Lastly, not all technologies seem to be equally as important to educators. It might be importan to figure out why. This research can help to take care of how many districts are spending on professional development for technology tools. Since teachers need time to change their practices, more money invested in technology professional development might lead to higher rates of technology use.

Conclusion, Limitations, & Recommendations

Overall, the high school science teachers in this survey had high levels of self-efficacy with course management systems and student wireless or digital devices, but not for social networking/media. It appears that achieving student outcomes were correlated with both the way teachers choose to teach using technology tools and their understanding of how to fit technology into the classroom and learning environments. The foremost limitation of this study is it used self-reported data, gained via email, and so there were no observations or interviews to see precisely how, and how well, the educators use these tools in the classroom. We can also assume that those willing to respond to an emailed, digital survey, would already be comfortable with technology. Therefore, future studies need to involve class observations of teachers using technology tools while teaching. This could also lead to valuable insights for administrators and fellow educators on how to best cultivate educator

self-efficacy levels through modern and meaningful professional development sessions.

Also, we asked the participants to fill out a question about the felt impacts of professional development on their efficacy for each tool, even if they had no professional development for that tool. We did this for ease of survey taking, but in doing so we forced the participants to fill out a question on professional development, even if they had had no professional development. This is likely what led to the decreased efficacy level for every tool when asked about the role of PD in their ability to use it. We assume that teachers who had not had PD responded to that statement with, Strongly Disagree. While we wanted to find correlations between the three aspects of efficacy, PD, and use of technology, future studies will need to better parse out the impacts of different types and durations of PD on technology use and efficacy in high school science classrooms.

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