

K-12 STEM Educator Autonomy: An Investigation of School Influence and Classroom Control

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Abstract

Over the past decade, teacher autonomy within the formal educational system has been a central topic of discussion among educational stakeholders. This study explored influence over school policy and classroom control (teacher autonomy) among in-service science, technology, and mathematics (STM) educators within the United States. The National Center for Education Statistics restricted-access dataset enabled examination of the study research questions. Specifically, the Schools and Staffing Survey Teacher Questionnaire (SASS-TQ) was employed for the purposes of this investigation. Analysis of data detected differences in both frame variables for influence and control. Hypothesis testing (independent sample t-tests) revealed differences between science and technology education, science and mathematics education, and technology and mathematics education teachers concerning influence over school policy and individual classroom control.

Introduction

National public school enrollment will exceed 54 million in the next several years (Hutchison, 2012), and with that a significant number of STEM teachers will be needed (Friedrichsen, Chval, & Tuescher, 2007; National Commission on Mathematics and Science Teaching for the 21st Century, 2000). President Obama planned to prepare 100,000 STEM teachers over the next decade and institute the STEM Master Teacher Corps that is intended to be a resource for best practices in science and mathematics instruction (The White House, n.d.). While the recruitment and preparation of highly skilled STEM educators represent substantial issues, the retention of experienced teachers is also a national priority (Newton et al., 2010). The retention of STEM teachers is a daunting task, as it is estimated that as many as 30% of teachers will abandon the profession in their first two years of service (Hutchison, 2012).

As a contributing factor to the “revolving door” in teaching, job satisfaction is one of the main influences on teacher retention when looking at why teachers leave the profession (Ingersoll, 2002; Perrachione, Peterson, & Rosser, 2008; Zhang, 2006). Job satisfaction within education can be defined as teachers’ affective reactions to their

work or teaching role, and can have serious impacts on teacher quality and student outcomes (Lee & Nie, 2014). Contributing factors supporting a teacher’s job satisfaction include teacher autonomy and influence over school policy (Boyd et al., 2011). Teachers with high job satisfaction often have high degrees of professional capabilities and feel that they are able to excel in challenging tasks (Gkolia, Belias & Koustelios, 2014). It is imperative that researchers look deeper into the factors of teacher autonomy and influence over school policy with the goal of retaining effective STEM teachers in the classroom.

Theoretical Framework

Historically, teacher fulfillment has consisted of a two-component system in terms of factors related to satisfaction: 1) environment and 2) personality (Butler, 2010). Eklund (2008), later investigated in the 2010 work of Butler, identified factors of: (a) support, (b) empowerment, (c) boundaries and expectations, (d) constructive use of time, (e) commitment to learning, (f) positive values, (g) social competencies, and (h) positive identity as both external and internal theoretical constructs. The linkage among satisfaction, autonomy, control, and influence of in-service educators is encapsulated in this approach, supported by base principles of various theories on motivation (Jorde-Bloom, 1986; Herzberg, 1966). Job satisfaction through examination of variables embedded as vocation-based features with motivational theory underpinnings has been an acceptable approach dating to the work of Hoppock in 1935. These investigations of satisfaction and autonomy of teachers have progressively developed into discipline-specific studies that inform and guide policy and structure through empirical evidence.

Literature from Prior Research

The effects of school climate on student success and belonging have been well-established (Haynes, Emmons, & Ben-Avie, 1997; MacNeil, Prater, & Busch, 2009); positive student outcomes occur in schools with high academic standards, collaborative and coordinated learning environments, and effective leadership. School climate is also associated with teacher outcomes and perceptions (Strong

& Yoshida, 2014; Dondero, 1997). Most notably, organizational autonomy is a central component of overall school climate (Gunbayi, 2007), wherein teachers have freedom to choose classroom goals and pedagogical methods and are in control of classroom content and practices. Teacher autonomy has been positively associated with improved job satisfaction and decreased on-the-job stress in multiple studies (Collie, Shapka, & Perry, 2012; Pearson & Moomaw, 2005; Skaalvik & Skaalvik, 2014).

However, legislation such as the *Elementary and Secondary Education Act (2001)* has inadvertently changed levels of teacher autonomy. The pressure for standards and accountability has caused more districts to prescriptively specify classroom content and practice in response to external pressure (Gonzalez, 2011). Increased demands result in greater challenges for all educators (Gkolia, Belias, & Koustelios, 2014). Evidence suggests that this external pressure highly correlates with teacher stress. Pearson & Moomaw (2005) found that as teacher autonomy through classroom influence and control increased, on-the-job stress decreased. In addition to reducing teacher stress, increased autonomy in the classroom is also associated with increased professionalism and teacher empowerment (Pearson & Moomaw, 2005). There is evidence that perceived teacher empowerment provides both intrinsic and extrinsic job satisfaction, affecting elements such as earned status and respect in addition to teacher autonomy (Bogler & Nir, 2012). Increased autonomy can increase a teacher’s self-confidence (Dierking & Fox, 2013) and may have a positive impact on retention (Center for Comprehensive School Reform and Improvement, 2007).

A majority of the teachers who left the profession reported greater autonomy in their new professions than was present in their classrooms (Marvel, Lyter, Peltola, Strizek, & Morton, 2007). Six dimensions of teacher autonomy have been identified: (a) involvement in decision-making, (b) opportunities for professional growth, (c) earned status and respect, (d) self-efficacy, (e) autonomy on the job, and (f) having an impact on other teachers, students, and events that take place in the school (Bogler & Nir, 2012; Short & Rinehart, 1992).

In addition to classroom autonomy, another factor related to teacher satisfaction is teachers’ freedom to par-

ticipate in school-based critical decision making (Strong & Yoshida, 2014). Teachers are more invested in schools when they are included or feel that they have influence over decisions (Blase & Kirby, 2009). Empowering teachers through involvement in management of school-wide issues can have positive impacts on job satisfaction (Vecchio, Justin, & Pearce, 2010). Jackson (2012) found that when teachers feel as if they have more influence over school policy, they are more inclined to remain in their current school. Novice teachers are more likely to leave due to a lack of influence over school policy. This trend can also be seen within veteran teachers, noting an increase in teachers leaving placements where they have less influence over school policy (Liu, 2007). Higher levels of teacher retention have been reported in settings where the teachers experience greater levels of influence over school policies and classroom control (Stockard & Lehman, 2004). This research explores the impact teacher autonomy, classroom control, and influence over school policy have in regards to job satisfaction by content-area specialty.

Research Questions

This study was guided by two research questions specific to STEM education teacher influence/control and differentiation between school climate reporting of in-service science, technology, and mathematics (STM) education teachers. Differences in autonomy are investigated collectively through reported levels of school policy influence and classroom control for STM education teachers. The questions posed by the researchers were:

1. To what extent are there differences in influence over school policy for STM education teachers?
2. To what extent are there differences in classroom control for STM education teachers?

Methodology

The Schools and Staffing Survey (SASS) is conducted by the National Center for Education Statistics (NCES) on behalf of the U.S. Department of Education in order to collect extensive data on American public and private elementary and secondary schools. SASS provides data on the characteristics and qualifications of teachers and principals, teacher hiring practices, professional development, class size, and other conditions in schools across the nation. The overall objective of SASS is to collect the information necessary for a comprehensive picture of elementary and secondary education in the United States. The amount and type of data collected permits detailed analyses of the characteristics of schools, principals, teachers, school libraries, and public school district policies. The SASS was designed to produce national, regional, and state estimates for public elementary and secondary schools and related components and is an excellent

<u>Variable</u>	<u>Science Ed.</u>	<u>Mathematics Ed.</u>	<u>Technology Ed.</u>
Weighted Sample	226,700	281,990	50,610
Mean Years of Experience	12.75	13.01	15.48
Male	86,520	98,050	38,150
Female	140,170	183,940	12,460

Note: Weighed sample values are rounded to the nearest 10 per IES protocol.

Table 1. Descriptive Information for Teacher Areas

resource for analysis and reporting on elementary and secondary educational issues (Tourkin, Thomas, Swaim, Cox, Parmer, Jackson, Cole, & Zhang, 2010).

Instrumentation

The 2011–12 SASS consists of five questionnaires: a School District Questionnaire, Principal Questionnaire, School Questionnaire, Teacher Questionnaire, and a School Library Media Center Questionnaire. This study analyzed data from the SASS Teacher Questionnaire (SASS TQ). The purpose of the 2011–12 SASS TQ was to obtain information about teachers, such as education and training, teaching assignment, certification, workload, and perceptions and attitudes about teaching.

There were in total 85 questions in the 2011–2012 SASS TQ comprising nine sections along with additional NCES frame and created variables. Variables are classified as frame variables, drawn from or based on a collection or subset of the SASS sampling frame. Created variables are based on survey variables, frame variables, other created variables, or a combination of these. These variables are frequently used in NCES publications and were added by the NCES to the restricted-use data files to facilitate data analysis (Tourkin et al., 2010).

This study consisted of a secondary analysis of the SASS dataset administered by the NCES. The methodology closely followed that of Ernst, Li, and Williams (2014) and Ernst and Williams (2014). Initial access was applied for and authorized by the NCES to Virginia Tech. The access provided a member of the research team with designated single-site user admittance. Specific protocol and reporting information was submitted to and subsequently accepted, where the NCES and Institute for Educational Sciences (IES) authorized approval and release. The NCES and IES require that all n's be rounded to the nearest 10 to assure participant anonymity. Therefore, data in tables and the associated narrative may not add to the total N reported because of rounding requirements.

Participant Selection

In this study, the participants who gave subject-matter codes relating to science, technology, or mathematics education for question 16 in the 2011–2012 SASS TQ, "This school year, what is your MAIN teaching assignment field

at THIS school?" were identified and placed in their respective disciplines. All data presented were weighted using the Teacher Final Sampling Weight variable and were appropriate for descriptive statistics. This resulted in 226,700 instances within the weighted results for science education, 50,610 instances for technology education, and 281,990 instances for mathematics education. Participant mean years of experience (SASS TQ item 12) and gender (SASS TQ item 78) are reported in Table 1. Data from the 2011–2012 SASS TQ for these groups were extracted and analyzed using descriptive and inferential statistics.

Variables Analyzed

Gender and Teaching Experience. The gender of STM education teachers was determined by SASS TQ question 78, "Are you male or female?" Teaching experience is calculated as the sum of all years taught full or part-time in public and private schools.

Influence Over School Policy and Classroom Control. Section VII of the SASS TQ is titled School Climate and Teacher Attitudes. For the purposes of this investigation, responses to items 61 and 62 were tabulated and analyzed. Item 61 of the SASS TQ gauges influence over school policy including 7 sub-items: 1. Setting performance standards for students at this school, 2. Establishing curriculum, 3. Determining the content of in-service professional development programs, 4. Evaluating teachers, 5. Hiring new full-time teachers, 6. Setting discipline policy, and 7. Deciding how the school budget will be spent. Teacher control over planning and teaching is measured in item 62 of the SASS TQ. Item 62 consists of six sub-items: 1. Selecting textbooks and other instructional materials, 2. Selecting content, topics, and skills to be taught, 3. Selecting teaching techniques, 4. Evaluating and grading students, 5. Disciplining students, and 6. Determining the amount of homework to be assigned.

The influence over school policy and classroom control were analyzed using SPSS 23.0 and AM Statistical Software. Independent sample t-tests were used to identify statistically significant differences. Probability levels of .05 or less were deemed to be statistically significant. Data were weighted using the Teacher Final Sampling Weight (TFNLWGT) variable, and the SASS supplied 88 replicate weight variables and utilized a balanced repeated replica-

Subject Area	Mean	SE (Mean)	SD	Minimum	Maximum
Science Ed.	14.809	0.167	4.373	7	28
Technology Ed.	14.902	0.266	4.359	7	28
Mathematics Ed.	14.68	0.167	4.228	7	28

Note: SE is Standard error. SD is Standard deviation.

Table 2. Subject area values for influence

Subject Area	Mean	Subject Area	Mean	Difference	df	t	p
Science Ed.	14.809	Technology Ed.	14.902	-0.093	88	-0.292	0.771
Science Ed.	14.809	Math Ed.	14.680	0.129	88	-0.511	0.610
Technology Ed.	14.902	Math Ed.	14.680	0.222	88	-0.780	0.021

Note: Ed. is Education. df is degrees of freedom. t is t-test value. p is probability level.

Table 3. Results from t-test for school influence

Subject Area	Mean	SE (Mean)	SD	Minimum	Maximum
Science Ed.	19.574	0.117	3.134	6	24
Technology Ed.	20.812	0.226	3.451	6	24
Mathematics Ed.	19.111	0.138	3.214	6	24

Note: SE is Standard error. SD is Standard deviation.

Table 4. Subject area values for control

Subject Area	Mean	Subject Area	Mean	Difference	df	t	p
Science Ed.	19.574	Technology Ed.	20.812	-1.238	88	-4.639	<.001
Science Ed.	19.574	Math Ed.	19.111	0.463	88	-2.438	0.017
Technology Ed.	20.812	Math Ed.	19.111	1.701	88	-6.586	<.001

Note: Ed. is Education. df is degrees of freedom. t is t-test value. p is probability level.

Table 5. Results from t-test for control

tion procedure as required by the IES to adjust standard errors. The coefficient of variation was calculated for each subject area and variable. They were all within IES guidelines and indicated that the results were stable and representative of the populations examined. (Tourkin, Thomas, Swaim, Cox, Parmer, Jackson, Cole, & Zhang, 2010).

Results

As previously indicated, descriptive and inferential statistical procedures were conducted to investigate teacher autonomy (influence and control) and decision making. A descriptive account of subject area values for

influence was tabulated in Table 2. There are notable variations in mean when factoring the subject areas of science education (14.809), technology education (14.902), and math education (14.68).

Research question one, "To what extent are there differences in influence over school policy for STM education teachers?" was analyzed and results are reported in Table 3 by paired subject areas.

Technology education was identified as having a statistically higher reporting of teacher influence over school policy than mathematics education. There were no significant differences detected between science educa-

tion and technology education nor science education and mathematics education concerning influence over school policy.

A descriptive account of subject area values for control were tabulated in Table 4. There are notable variations in mean when factoring the subject areas of science education (19.574), technology education (20.812), and math education (19.111). Overall, technology education teachers reported the highest level of classroom control followed by science education and then mathematics education.

For the second study question, "To what extent are there differences in classroom control for STM education teachers?" data were analyzed and reported in Table 5. Factoring classroom control, there are significant separations detectable between science education and technology education, science education and mathematics education, as well as technology education and mathematics education.

Analysis of data detected differences in both frame variables for influence and control. In testing the stated hypotheses, there are identifiable differences between science and technology education, science and mathematics education, and technology and mathematics education.

Discussion

Previous studies have identified how teacher autonomy and perceived influence over school policy can positively affect teachers' job satisfaction and, as a result, job retention (Ingersoll, 2002; Perrachione, Peterson, & Rosser, 2008; Zhang, 2006). However, few studies had investigated differences among teachers of different subjects. In our analysis of the Schools and Staffing Survey (SASS), we found that subject-specific differences did exist: technology education teachers showed an increased level of school influence when compared to mathematics educators. Furthermore, technology education teachers also reported a higher level of classroom control than their science and mathematics counterparts.

Areas of potential interest for future research exist in some of the variables not controlled for, such as a comparison by grade level or level of pedagogical training of the teachers. In states that allow alternative licensure paths for industry professionals to enter teaching without education degrees, there may be higher proportions of these teachers in technology education. Mathematics and science departments within schools may also be larger due to technology education often being an elective course. This may lead to less collaborative planning and more autonomy for technology educators. Technology education may also represent non-sequential courses and instructors may have more control over the time lines and areas of focus within their classrooms. Although these factors represent potential limitations of this study, they also offer areas for further investigation.

Implications

In the current climate of increasing curricular and pedagogical oversight, such outcomes have immediate applicability and impact. The adoption of common standards such as the Common Core and Next-Generation Science Standards may affect teachers' perceptions of classroom control and influence and, thus, autonomy. For school subjects that are part of this standardized curriculum (and the often high-stakes testing that accompanies them), the teachers may perceive or experience a loss of autonomy or control. In comparison, technology education is rarely included in the standards-based, high-stakes testing initiatives; it is not among the subjects used as a metric for regional, national, and international educational comparisons. Therefore, there may be less pressure on technology educators than on science and mathematics teachers who are evaluated on their students' test scores. This may lead to technology education teachers having a greater sense of perceived flexibility to build more individualized and/or customized classroom experiences.

Conclusions

Among STEM teachers in our study, technology education teachers had the highest levels of classroom control and school influence. Previous studies have found relationships between these factors and teacher retention. The extant literature suggests that these factors positively associate with teacher autonomy (Gunbayi, 2007). There is also clear evidence of low levels of teacher autonomy contributing to negative trends in job satisfaction and teacher retention, resulting in the loss of veteran teachers who do not continue their careers in education (Ingersoll, 2002; Perrachione, Peterson, & Rosser, 2008).

The data from the SASS database, as well as the scope of this study, do not allow for deeper analysis of this phenomenon. The significant differences among STEM teachers merits further investigation. If the United States intends to retain experienced teachers in our schools, efforts should be made to discern the factors that positively or negatively influence perceptions of classroom control and school influence. Identifying pertinent factors may not stop the "revolving door" in the teaching profession, but addressing these areas of teacher autonomy may serve to slow it down.

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