A New Framework for STEM Teacher Education in Urban Settings: Focus Group Discussions

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Abstract: The School of Education in University of Bridgeport developed a framework for a combined innovative Teacher Fellowship/Master Teacher Fellowship (TF/TMF) program that will provide advanced science content, pedagogical knowledge, and complex instructional leadership skills for in-service high school teachers and for STEM graduates who are willing to teach science in high-need school districts in Connecticut. During the preparation of this framework, we gathered information via interviews, focus group discussions, and surveys. A group of secondary education physics teachers from Connecticut school districts participated and provided their insights about the current issues and challenges of their profession. This paper presents the data which is gathered together from meetings with the teachers. We have also included the supporting data from US Department of Education and CT State Department of Education.
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Introduction:

One of the roles of secondary education is to discover, stimulate, sustain and channel students' interest towards their future professional careers. How teachers teach and what students learn in a STEM classroom has an important impact on how many students choose a STEM-related career and how successful they are in their undergraduate studies. Engineering education starts in the K-12 STEM classrooms. What happens there is important for post-secondary engineering education and impacts not only engineering students' enrollment in higher education institutions, but also their quality of learning and their undergraduate degree completion rates. Moreover, effective teaching in the K-12 STEM classrooms has the potential to attract diverse groups of students, such as women and other underrepresented minorities, into pursuing a career in engineering.

The United States has a long-term shortage of qualified physics teachers. A former study by the American Institute of Physics (AIP) reported that the proportion of high school students who take physics has risen significantly, from about 20% to 28%, between 1989 and 1999. Yet, one-third of the 30% of public school principals had difficulty finding qualified physics teacher candidates. More than a decade later, in 2013, the National Task Force on Teacher Education reported that "*the need for qualified physics teachers is greater now than at any previous time in U.S. history*." Since 1999, the enrollment in high school physics has risen about 50% (Figure 1). According to the Department of Education, only 47% of physics classes are taught by a teacher with a degree in the subject (Figure 2) [1].

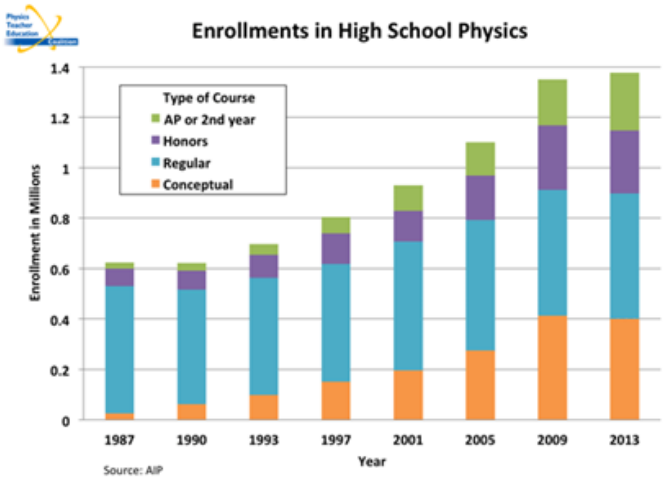

Figure 1. Physics enrollment in U.S. high schools [2]

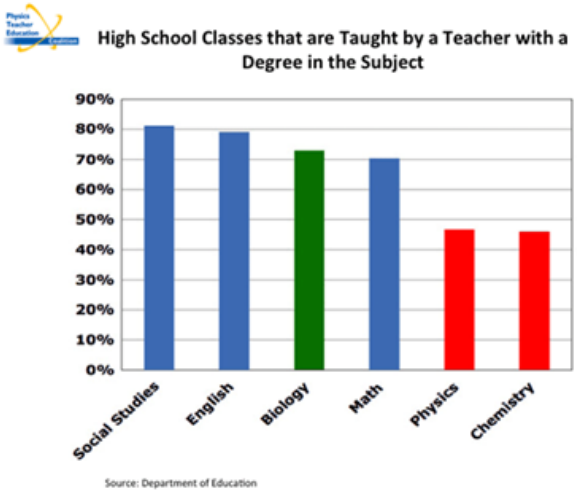

Figure 2. Fraction of high school classes taught by teacher with degree in subject [1]

It is reported that teachers of physics at high poverty schools are less likely to have a degree in physics or physics education [3]. This problem continues feeding the large and persistent science achievement gap among races and ethnicities. Grigg et al. reported that 65% of white students were at or above the basic level in science compared to 19% of black and 30% of Hispanic students [4].

Considering that nearly two-thirds of physics education graduates teach within 50 miles of the university where they were educated, it is important to offer physics teacher preparation programs by the institutions which are located in high need school districts. In Connecticut, the percentage of urban students considered at goal and proficient in secondary science is well below the state average. This has impacted the state's workforce quality, resulting in negative consequences for Connecticut's economy and competitiveness. In consequence, our research concentrates on the recruitment and preparation of secondary physical science teachers, with the final goal of improving urban STEM education and hence, recruiting more underrepresented minorities from urban areas into STEM-related careers, such as engineering. Our research method includes the analysis of students' academic performance in secondary physical science in conjunction with the information provided by physics teachers. Via interviews, focus group discussions, and surveys in 2015, a group of secondary education physics teachers from Connecticut school districts participated in the project and shared their insights about the current issues and challenges of their profession.

All participants agreed that the main characteristics of those physics teachers who remain in the profession include *honesty, certain love of the subject, passion for the physics, sense of enthusiasm, sense of humor, enjoying kids, personal connections, and creativity.* It is mentioned that those who leave the profession are either not fit to the profession or have not received support from their schools. It is thought that adults who enter the profession later in their

life are challenging to prepare and to mentor. Younger adults are considered to be easy to prepare for the profession. In the meanwhile, student teachers think it would be easier once they have their own classroom but later they realize it is not. This issue causes frustration among young physics teachers and eventually it may lead to leave the profession. *Exposure to reality* is important.

Leaving financial issues aside, successful school districts retain their physics teachers by providing *a cohesive work environment and support system*. One of the focus group participants talked about their regular weekly meetings with feeder teachers (chemistry and biology teacher) to share their teaching experiences with the hope that they could incorporate those teaching strategies in their classroom. The entire focus group agrees about the importance of teaching strategies. Feeder teachers are considered as a good source to support singleton physics teachers in schools.

Our focus group shared their ideas for effective strategies for bringing new teacher into the profession. The group agreed that physics is one of the polarizing subjects. It is a hate or love relationship. The impact of *an effective, engaging, and friendly teacher* is important to form a love relationship between students and physics class. *Internship programs for high school students* to help science classes can be a tool to encourage students to pursue a career as a science teacher. Such programs will also give an opportunity to students to decide if teaching is the right profession for them in future. It is also brought up that offering *a teacher preparation minor in high schools* can be a useful recruitment strategy.

It is thought that students tend to learn better with teachers who are like them though there is no solid data to support it. This is a controversial subject. The data from a randomized field trial conducted in Tennessee (Project STAR: Student Teacher Achievement Ratio) reported that black students learn more from black teachers and white students from white teachers [5]. The racial dynamics within classrooms may affect students' performance academically. However, this study employed a cohort of students from kindergarten through 3rd grade. Such study may present different results for high school students who take science classes. So, recruiting more teachers from underrepresented minority groups to close achievement gaps in high need school districts is debatable. On the other hand, there is an urgent need to recruit minority teachers. Our focus group teachers brought up the need for minority teachers in the profession during our meetings. The following data presents the unbalanced teacher workforce in USA. U.S. Department of Education released the report on the student population versus teacher population based on their ethnicity in 2000. While the 17% of the student population in America's public schools is African-American, only the 8% of the teacher population is African-American. The same case applies to the other minorities (Figure 3).

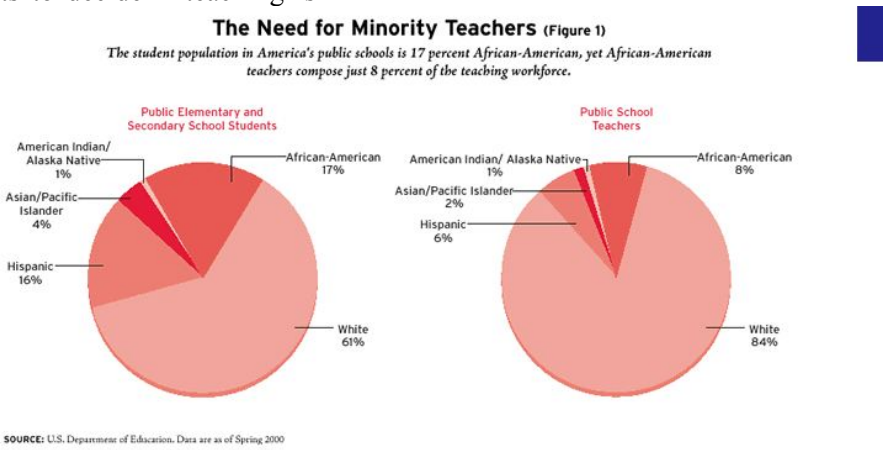

Figure 3. The ethnicity profile of students and teachers in USA, 2000. [6]

Connecticut as many other states is in need of minority teachers. CT State Department of Education released the data (Table 1) for Hartford public schools in 2015. It is distressing the need of an urgent action. In 2015, the percent of Hispanic and African-American general education teachers dropped about 5% compared to that of in 2005 [7].

Table 1. The ethnicity profile of teachers in Hartford public schools between 2004-2015, CT [7]
(Public staffing data provided by the State Department of Education (CEDAR)

Hartford Public Schools - Gen. Ed. Teachers	White Teachers #	Percent White Teacher	Latino Teachers #	Percent Latino Teachers	Black Teachers #	Percent Black Teachers	Total Teachers
2004 -05	957	67.97%	213	15.13%	221	15.70%	1408
2005 -06	1027	70.88%	204	14.08%	202	13.94%	1449
2006 -07	1057	71.86%	195	13.26%	199	13.53%	1471
2007 -08	1068	73.45%	180	12.38%	189	13.00%	1454
2008 -09	1052	73.67%	172	12.04%	185	12.96%	1428
2009 - 10	973	73.99%	159	12.09%	161	12.24%	1315
2010 -11	985	75.02%	148	11.27%	156	11.88%	1313
2011 -12	1002	75.34%	146	10.98%	152	11.43%	1330
2012 -13	1052	77.24%	133	9.77%	146	10.72%	1362

Teacher/student diversity in Norwalk schools in CT is very similar to the Hartford data (Table 2). While 19.3% of the student body is African-American, only the 5.89% of the teacher body is African-American. It is more dramatic for Hispanic group. While the 39.2% of the students is Hispanic, only the 6.23% of the teachers have Hispanic background.

Table 2. Norwalk Schools: Teacher versus student diversity [8]

NORWALK SCHOOLS: TEACHER VERSUS STUDENT DIVERSITY		
RACE	**TEACHERS**	**STUDENTS**
WHITE	757 (85.8%)	3878 (35%)
BLACK	52 (5.89%)	2144 (19.3%)
HISPANIC	55 (6.23%)	4350 (39.2%)
ASIAN	15 (1.7%)	534 (4.8%)
OTHER	3 (0.38%)*	185 (1.7%)**
TOTAL	882	11091

* OTHER TEACHERS REPRESENT THREE INDIAN TEACHERS IN THE DISTRICT.

** OTHER STUDENTS REPRESENT THE REMAINING NUMBERS LEFT OVER AFTER SUBTRACTING WHITE, BLACK, HISPANIC AND ASIAN STUDENTS FROM THE TOTAL.

Source: Norwalk Public Schools

The need for certified science teachers is another urgent matter in the profession. This issue is mentioned by the science teachers in our focus group. It is stated that once a new teacher who is not a minority gains a few years of experience working in high need school districts, he/she most likely desires to land a teaching job in other school districts. Minority teacher recruitment and retention might be a solution of retaining the certified science teachers in low income, high need school districts and balancing the K-12 workforce. Figure 4 depicts the percent of students enrolled in schools with more than 20 percent of teachers not yet certified, by student race and ethnicity.

According to national data from the 2011-12 school year released by the U.S. Department of Education's Office of Civil Rights [9], African-American students are more likely to be taught by uncertified teachers, novice teachers, or teachers with lower salaries than their peers. These data supports our focus group's statement.

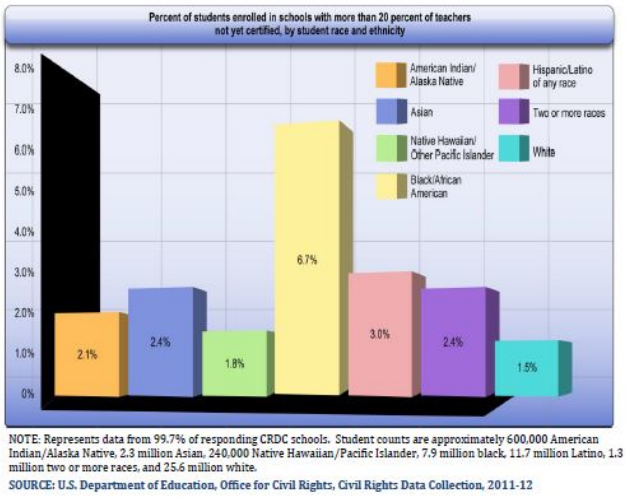

Figure 4. The percent of students enrolled in schools with more than 20 percent of teachers not yet certified, by student race and ethnicity [9]

Conclusions:

In short, we can summarize the outcomes of our interviews, focus group discussions, and surveys with K-12 science teachers as below.

1. A teacher who stays in the profession should possess honesty, certain love of the subject, passion for the physics, sense of enthusiasm, sense of humor, enjoying kids, personal connections, and creativity.
2. Early exposure to reality is important especially for new teacher.
3. Successful school districts retain their physics teachers by providing a cohesive work environment and support system.
4. Physics is one of the polarizing subjects. It is a hate or love relationship.
5. Internship programs for high school students to help science classes can be a tool to encourage students to pursue a career as a science teacher.
6. A teacher preparation minor in high schools can be a useful recruitment strategy.
7. There is an urgent need to recruit minority teachers.
8. The need for certified science teachers is another urgent matter in the profession.
9. Minority teacher recruitment and retention might be a solution of retaining the certified science teachers in low income, high need school districts and balancing the K-12 workforce.

After integrating the information from all data sources, we have developed a framework to increase the recruitment, retention, and support of science teachers who commit to teaching in secondary urban schools. In addition, we have identified effective approaches to training science teachers in order to implement successful science instruction in urban settings. Our findings have implications for the training of secondary science teachers from urban schools. Our developed framework for the recruitment, preparation, and support of science teachers will address the suggestions and concerns of the science teachers in our focus group and it can serve as a model for urban settings.

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