Overview and Introduction

Excerpts from:

The Role, Education, Qualifications and Professional Development of Secondary School Physics Teachers

https://www.aapt.org/Resources/upload/Secondary-School-Physics-Teacher-Role_booklet.pdf

Overview

This document is the result of the work of a subcommittee of the American Association of Physics Teachers (AAPT); this subcommittee was established by the AAPT Committee on Physics in High Schools and eventually became a joint effort with the AAPT Committee on Teacher Preparation. The primary intent of the document is to provide guidance to secondary school administrators in the evaluation and professional support of physics teachers. Administrators may find the information provided in section 2 (Role of a Physics Teacher) and section 3 (Education and Qualifications) particularly valuable for this purpose. The writing committee also believes that the document will be beneficial to in-service teachers who wish to improve their teaching through professional development. In-service teachers may find information in section 4 (Professional Development) of particular interest, in addition to sections 2 and 3.

1. Introduction

The following statement from *The Role, Education, and Qualifications of the High School Physics Teacher* (AAPT Committee on Special Projects for High School Physics, 1988) describes both its focus and that of this document, which is an update of that earlier publication.

> "Excellence in high school physics depends on many things: the teacher, course content, availability of apparatus for laboratory experiments, a clear philosophy and workable plan for meeting students' needs, serious dedication to learning goals, and adequate financial support. The role of the teacher, however, is the most important. Without a well-educated, strongly motivated, skilled, well-supported teacher, the arch of excellence in high school physics collapses. The teacher is the keystone of quality."

Education research has continued to show that an effective teacher is the single most important factor of student learning (Darling-Hammond, 2000; Marzano, 2007). Marzano characterizes an effective teacher as one who matches the strategies to the students.

In *Physics at the Crossroads* (Hilborn, 1996) the author argued that physics education was at a "critical juncture". Introductory physics courses were criticized because students who completed them lacked preparation for more advanced courses, an understanding of physics, and an ability to apply the ideas. The ideas expressed in this report are still a concern in physics education.

Factors that affect the actual teaching of physics have changed since publication of *The Role, Education, and Qualifications of High School Physics Teachers* (AAPT Committee on Special Projects for High School Physics, 1988). George D. Nelson describes these changes as an evolutionary framework consisting of four generations of instructional change (Nelson, 2006). He characterized the four generations as follows:

- Generation 1 was a traditional approach using textbooks with the students as passive learners. Information was presented to the students in a lecture format and assigned readings in a textbook were supplemented by demonstrations and, possibly, "cookbook" laboratory activities. Students were responsible for solving problems after the teacher showed them examples of how this type of problem was solved. After the launch of Sputnik, different ideas on teaching physics emerged. Various programs were developed, including *PSSC Physics* (PSSC Article Collections) and *Harvard Project Physics* (Holton, 1969), as a result of funding from the National Science Foundation. These programs served as a bridge to Generation 2.
- The Generation 2 ideas of teaching style changed drastically to promote student-centered learning rather than the teacher-centered model in Generation 1. Teachers needed additional professional development to employ the constructivist strategies in their classes.
- Since 1997, a Generation 3 emerged, using cognitive research-based materials to support constructivist learning. Generation 3 may incorporate technology for collecting and analyzing data and conducting simulations to compliment student development of cognitive understanding of science concepts. Formative assessment is a key factor to enable the teacher to pose questions and help guide students in their quest for understanding of scientific concepts.

- According to Nelson, Generation 4, an approach involving teacher collaborative learning communities, is the next step. These changes in the teaching of physics pose challenges for the preparation of physics teachers.

Many states have implemented a standards-based science curriculum in grades K – 12 that is often based on the *National Science Education Standards* (National Research Council, 1996). Teachers are responsible for implementing the standards-based curriculum and preparing the students for state tests in science as well as existing tests in mathematics and language arts. The effective teaching of physics includes using strategies to promote constructivist learning, conceptual understanding of physics topics, and to develop skills and methods for students to understand the process of scientific inquiry. These teaching strategies include the use of cooperative learning, technology tools, activities performed in order to collect, analyze and report data. The teacher needs to understand the use of formative and summative assessments and techniques to create a learning environment where students share the responsibility for their own learning. As our understanding of how to more effectively engender student learning grows this altered understanding is leading to changes in teacher preparation but it also indicates the need for ongoing professional development.

In addition to our changing understanding of how people learn, physics teachers today are facing a greater variability in terms of students' academic preparation, educational expectations, epistemologies, and demographics than in years past. The need to better engage this changing population adds support to the necessity for ongoing professional support.

Science teacher education is changing. The National Science Teachers Association (NSTA) has published reports that describe standards and the revisions needed within science teacher preparation to support students achieving these standards. The standards were based on the review of professional literature and the *National Science Education Standards* (NRC, 1996), which we will reference as *(NSES)*, and were designed to be a performance assessment tool at certain times during a teacher preparation program. The first three areas of the NSTA *Teacher Preparation Standards* (NSTA, 2003) deal with preparation in subject matter, the nature of science, and inquiry as a methodology for teaching and learning. The remaining seven standards deal with preparation for teaching students to become more informed about science issues, preparation to meet the needs of students, curriculum, science in the community, assessment,

safety in the classroom, and professional growth. The standards offer a general outline of areas that should be included in courses and experiences for the preparation of physics teachers.

This revision of *The Role, Education and Qualifications of the High School Physics Teacher* (AAPT Committee on Special Projects for High School Physics, 1988) is based on the perspective of the current reform in physics education. What is the role of the physics teacher in the classroom and the community? What education and qualifications will help physics teachers be effective in helping students learn physics? What are personal attributes of physics teachers that help them be successful? And finally, what types of professional development opportunities will help teachers continue to grow as teachers?

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