Investigating the effects of teacher training on learning physics

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Abstract

Teachers, like students, have preconceptions. Just as pupils' learning of science is conceived of as conceptual, epistemological and attitudinal change, so should teachers' learning of didactics. Teachers' knowledge, like students', must build on the previous knowledge they have. There is a close parallel between how change occurs in conceptions of science and how it occurs in conceptions of teaching. When teachers have developed a conceptual understanding of the Physics content that they are expected to teach greatly increases their confidence in their ability to deal with un expected situations in the classroom. The assessment of the effectiveness of a physics program for the teacher training should focus on how well they understand the content and process of physics. A major incentive for conducting such a program is to improve student learning. Therefore, it is also important to assess the effect of the type of preparation that teachers have received on the intellectual development of their students. A preview of some researches shows: (1) Subject competence is essential to teacher effectiveness. (2) Proficiency in scientific inquiry is more important than specific content knowledge. (3) Managing the quality of classroom discourse is the single most important factor in teaching with interactive engagement methods. (4) Teachers create an environment where in students construct their own understanding of the subject. The quality of the constructions depends crucially on the conceptual tools available to the students and facilitation by the teacher. (5) Effective teaching requires complex skills which take years to develop. Technical knowledge about teaching and learning is as essential as subject content knowledge. Few teachers can acquire it without participating in a strong program of professional development. However, most are capable of achieving a high level of teaching proficiency, and even the best need the stimulus of peers to keep improving. Though good teaching is a skill that can be learned by most physics teachers, it may be that great teaching requires a special talent and great teachers are great learners who love to share the sources of their inspiration.

Keywords: Physics Education, teacher training, learning Physics.

Resumen

Los maestros, como estudiantes, tienen ideas preconcebidas. Así como el aprendizaje de los alumnos la ciencia es concebida como el cambio conceptual, epistemológico y cambio actitudinal, por lo que los profesores, así los profesores deberían aprender de didácticas. El conocimiento de los maestros, al igual que los estudiantes, deben basarse en los conocimientos previos que tienen. Hay un estrecho paralelismo entre cómo ocurre el cambio en las concepciones de la ciencia y la forma en que se produce en las concepciones de la enseñanza. Cuando los profesores han desarrollado una comprensión conceptual de los contenidos de la Física que se espera que se enseñen, aumenta su confianza en su capacidad para hacer frente a situaciones que se presenten en el aula. La evaluación de la efectividad de un programa de Física de la formación de los docentes debe centrarse en qué también se entiende el contenido y el proceso de la Física. Un incentivo importante para realizar dicho programa es mejorar el aprendizaje del estudiante. Por lo tanto, también es importante para evaluar el efecto del tipo de preparación que los maestros han recibido en el desarrollo intelectual de sus estudiantes. Una vista previa de algunos programas de investigaciones: (1) Asunto competencia es esencial para la eficacia de los maestros. (2) Competencia en la investigación científica es más importante que el conocimiento de contenido específico. (3) Gestión de la calidad del discurso en el aula es el factor más importante en la enseñanza con los métodos de participación interactiva. (4) Los profesores crean un ambiente donde los estudiantes construyen su propio entendimiento del tema. La calidad de las construcciones depende fundamentalmente de las herramientas conceptuales disponibles para los estudiantes y la facilitación por parte del profesor. (5) La enseñanza eficaz requiere habilidades complejas que tardan años en desarrollarse. Conocimientos técnicos sobre la enseñanza y el aprendizaje son tan esenciales como el conocimiento contenido en la asignatura. Pocos maestros pueden adquirir su participación en un pequeño programa de desarrollo profesional. Sin embargo, la mayoría son capaces de alcanzar un alto nivel de aptitud para la enseñanza, e incluso los mejores necesitan el estímulo de sus compañeros para seguir mejorando. A pesar de la buena enseñanza es una habilidad que puede ser aprendida más por los profesores de Física, puede ser de gran enseñanza, requiere un talento especial y los grandes maestros son grandes aprendices que gustan de compartir las fuentes de su inspiración.

Palabras clave: Educación en Física, formación de profesores, aprendizaje de la Física.

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I. INTRODUCTION

Science Education Research has shown the differences between the goals of curriculum developers and what teachers actually practice. Those differences have called attention to the influence teachers exert in the implementation of science curricula in high schools. In addition there are a high percentage of pupils who fail in physics and pupils' negative attitudes towards physics learning grow steadily. Those results have broken simplistic views about physics teaching as an activity which demands just a sound scientific knowledge and some experience. In other words, those results have made clear that teacher training cannot be reduced to just scientific courses, as it has been usually. A possible solution is to complement the scientific courses with other courses about Education. Monitoring the learning process in classroom needs a lot of skills which help teachers to teach in good way. One of these skills is subject matter that we want to investigate the necessity of it on high school teacher training courses in Tehran Educational Organization.

II. SUBJECT MATTER AS A SKILL FOR TEACHERS

In this point of view, subject matter is a necessity for teacher training and should be taught. There are some parts which include:

1- Knowing the problems that raised the construction of the knowledge to be taught, without which, knowledge seems to have been built up arbitrarily. Knowing the History of Science, not only as a basic aspect of scientific culture, but ultimately, as a means of associating scientific knowledge with the problems that led to the building up of this knowledge. Above all, knowing what difficulties were faced in the building up of this knowledge; the epistemological obstacles involved; since this knowledge constitutes an essential aid to understanding students' difficulties, knowing as well how this knowledge developed and how the various points came to be joined up into one consistent body of knowledge, and, consequently, avoiding static and dogmatic views that distort the very nature of scientific work.

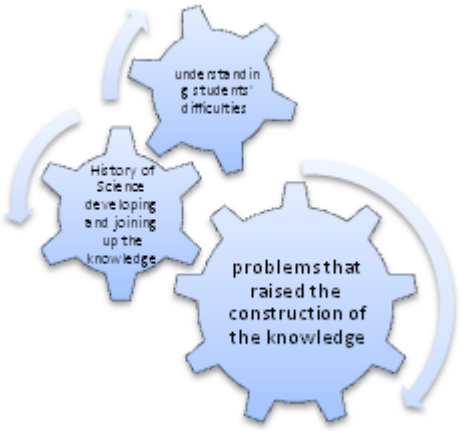

FIGURE 1. Some parts in teacher's knowledge.

2- Knowing the methodological orientations employed in the construction of knowledge. In other words, knowing how researchers approach problems, the most notable features of their activity, and the criteria used to validate theories. This knowledge is essential to the appropriate orientation of laboratory practices, to solving problems, and to the students' construction of knowledge.

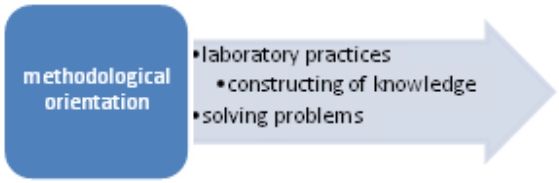

FIGURE 2. Methodological orientation by knowing how researchers approach problems, the most notable features of their activity, and the criteria used to validate theories.

3- Knowing the Science/Technology/Society interactions. This is essential to give a correct image of physics, since scientists' work is not carried out apart from the society in which they live -- it is affected by the problems and circumstances of the historical moment -- and their actions clearly influence the surrounding physical and social environment.

4- Acquiring some knowledge of recent scientific developments to transmit a dynamic, non-closed view of physics. It is likewise necessary to acquire knowledge of other related areas to be capable of approaching the "frontier problems", the interactions among the various fields, and unification processes.

5- Knowing how to choose appropriate content, accessible to students and capable of arousing their interest and given a correct view of physics.

6- Being prepared to deepen the knowledge acquired during the initial teacher training courses contemplating the scientific advances and curricular changes [1].

III. THE IMPORTANCE OF TEACHER TRAINING PROGRAM

Teachers' knowledge, like students', must build on the previous knowledge they have. There is a close parallel between how change occurs in conceptions of science and how it occurs in conceptions of teaching. When teachers have developed a conceptual understanding of the Physics content that they are expected to teach greatly increases their confidence in their ability to deal with unexpected situations in the classroom [2].

The assessment of the effectiveness of a physics program for the teacher training should focus on how well they understand the content and process of physics. A major incentive for conducting such a program is to improve student learning. Therefore, it is also important to assess the effect of the type of preparation that teachers have received on the intellectual development of their students [3].

A preview of some researches shows: (1) Subject competence is essential to teacher effectiveness. (2) Proficiency in scientific inquiry is more important than specific content knowledge. (3) Managing the quality of classroom discourse is the single most important factor in teaching with interactive engagement methods. (4) Teachers create an environment where in students construct their own understanding of the subject. The quality of the constructions depends crucially on the conceptual tools available to the students and facilitation by the teacher. (5) Effective teaching requires complex skills which take years to develop.

IV. RESULTS

We have done a survey in appropriate titles for teacher's knowledge in a teacher training program, participating 25 physics teachers. The results show the necessity of each title in this program (mean number is from 5).

TABLE I. Appropriate cases for teacher's knowledge in a teacher training program**.**

	Title	Mean
1	knowing the problems that raised the construction of the knowledge	4.3
2	knowing the history of science, as a means of associating scientific knowledge	3.2
3	knowing what difficulties were faced in the building up of knowledge	2.9
4	knowing how the various points came to be joined up into one consistent body of knowledge	3.0
5	knowing the methodological orientations employed in the construction of knowledge	1.9
6	knowing the science/technology/society interactions	3.4
7	acquiring some knowledge of recent scientific developments	4.1
8	knowing how to choose appropriate content for students to arouse their interest and give a correct view of physics.	3.7
9	knowing how to deepen the knowledge acquired during the teacher training courses contemplating the scientific advances and curricular changes.	3.2

Results show knowing the problems that raised the construction of the knowledge is the first priority for teacher training in this group of teachers and the next priorities are: acquiring some knowledge of recent scientific developments and knowing how to choose appropriate content for students to arouse their interest and give a correct view of physics. Of course these three cases are related to cultural education background of society. So some teacher training programs have to focus on these three factors although other cases are important for next programs.

V. CONCLUSIONS

This plan took place in high school teacher training courses in Tehran Educational Organization and it shows the teacher training courses programs has to focus on construction of the knowledge of students, recent scientific developments and planning best content to improve students' interests in learning physics.

Therefore technical knowledge about teaching and learning like construction the knowledge of students is as essential as subject content knowledge. Few teachers can acquire it without participating in a strong program of professional development. However, most are capable of achieving a high level of teaching proficiency, and even the best need the stimulus of peers to keep improving. Though good teaching is a skill that can be learned by most physics teachers, it may be that great teaching requires a special talent and great teachers are great learners who love to share the sources of their inspiration [4].

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