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STUDENT TEACHING IN NONWESTERN SCIENCE CLASSROOMS:

ANALYSIS OF VIEWS FROM POTENTIAL PARTICIPANTS IN THE PROGRAM

Práctica docente de licenciados de Ciencias Naturales en Escuela no Occidental : análisis desde el punto de vista de participantes potenciales de Programa

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Abstract

Student teaching has been an integral part of the education and training of science teachers. Although many educators doubt the adequacy and effectiveness of such programs in equipping student teachers with the necessary skills, few research works have investigated the case from the point of view of all the participants in the program, particularly in African countries. In this research thus an attempt is made to survey the student teaching program for science teachers in the Addis Ababa University (Ethiopia). The views of the University subject area methods' instructors, school deputy principals, cooperating teachers and student teachers of secondary science are investigated and analyzed. Finally suggestions that focussed on University-School-Science Classroom levels have been put forward.

Key Words: Student-teaching, Teaching-practice, Secondary science, Non-western classroom

Resumen

La práctica docente es importante parte de preparación para licenciados en Ciencias Naturales lo que permite que futuros profesores adquieran conocimientos y habilidades necesarias. En este trabajo se muestra el programa para práctica docente de estudiantes de Universidad de Addis Ababa, Etiopía, la cual refleja métodos de enseñanza, cooperación de maestros y estudiantes. Las conclusiones están enfatizadas en las relaciones universidad-bachillerato-aula escolar.

Palabras clave: Práctica docente, ciencias para bachillerato, escuela no occidental

Introduction

Despite the overwhelming support for student teaching as an integral part of teacher education, the conventional programs have been criticized for lack of effective models and of specific instructions (Borg, et al., 1970). Some educators even see no reason to consider such programs an effective way to educate teachers (Cochran-Smith, 1991; Zahoric, 1988).

Science education, despite the scarcity of research evidence, shares the above mentioned criticisms. For Willson and Horn (1979) the difference in science teaching attitudes among cooperating teachers, school principals, college /university teacher trainers and student teachers is the main obstacle for effective science teachers training. Hacker (1988) also recognized the degree of integration of teaching practice with theoretical studies, rather than length of teaching practice, as the main factor in students' rates of professional growth.

However, although science is taught at all levels of today's Africa (Ogunniyi, 1996), the writer of this article could not find any published research work which investigated the programs for student teachers of science in Africa. The relevance of research findings from other parts of the world is unquestionable. However, it is felt that investigating the state of the training of science teachers vis-a-vis the prevailing University-School-Classroom situations in African countries is of greater importance. It is important because, first of all, the training of effective and professional science teachers is considered to be part of the development of science and technology human resources in Africa. Research on such human resource development is urgently needed (Ogunniyi, 1996). Secondly, such researches could provide relevant facts to researchers on science education who strive for better models of science teaching. Such models should consider cross-cultural factors. To this effect, the case in Ethiopia, Addis Ababa University, will be discussed here. The following gives an overview of the program.

The teaching stream students in the Addis Ababa University should take 28 credit hours (One ‘credit hour’ represents one contact hour for one semester) of professional (education) courses. Student teaching is part of a 4 credit hour course, Subject Area Methodology and Practice Teaching, for final year students of a B.Sc./B.A. degree. The theoretical subject methodology is offered in the first 9 to 10 weeks of the semester. The practice teaching lasts for 5 consecutive weeks the first of which is used for observing the regular teacher to be replaced in the next 4 weeks. In these 4 weeks the student teachers take full responsibility for teaching their subjects for 4 periods (each 40 minutes) per week. For the history and administration of the program, see Bekele, et al (1994); Zewdie (1995).

During this period of school experience the school teachers are provided with the supervision format and evaluate the student teachers 3 times at most (once per week). The subject methods' instructors randomly supervise the student teachers. The deputy principals are usually the ones who introduce the school regulations to the student teachers. The instructors then administer final written examinations on the course. The final grade for this course is determined by the instructors based on the student teacher's (a) performance on this exam, and (b) cumulative point on the supervision format (given by the cooperating teachers). The student teachers are entitled to teach in any one of the senior secondary schools of Ethiopia after graduation. There is no special graduation requirement related to the teaching practice as long as it is satisfactory.

Methods

The major data collecting instruments are questionnaires, supervision formats, panel discussions and observation of student teachers of secondary science during teaching practice. More specifically, data were collected (1) through a questionnaire from 19 (83%) chemistry and 11 (100%) physics 4th year students who completed their teaching practice at secondary schools in the first semester of the 1996/97 academic year; (2) by analyzing the comments given on the evaluation format by the cooperating teachers to the above student teachers; (3) by effectively using the criticisms and suggestions raised during a panel discussion whose participants were drawn from school principals, cooperating teachers, university science educators and guest teacher trainers from UK; (4) by using, when appropriate, the writer’s experiences as an instructor for the course on chemical education and also as university supervisor of chemistry student teachers for the last ten years. The above sources are thus sufficient enough to provide reliable data about the state of student teaching in the science subjects. However, due to schedule of the University it was found impossible to include Biology student teachers in this study. Taking into account the extreme uniformity and centrality of the student teaching program, it is argued that such a limitation is tolerable and hence does not seriously affect the findings of the study.

Results and Discussions

Student Teachers’ Views

The student teachers were assigned to teach in grades 9 and 10 (see Table 1). There is a tendency, not a rule, **not** to assign the student teachers to teach in the higher grade levels.

Table 1. The Science Classrooms in which the Student Teachers were Teaching

Questionnaire Item	Number (%) of Student Teachers		
	Chemistry	Physics	Total
Grade Level 9	9 (47.4)	8 (72.7)	17 (56.7)
10	10 (52.6)	3 (27.3)	13 (43.3)
Average No. of Students			
50-60	4 (21.1)	3 (27.3)	7 (23.3)
61-70	4 (21.1)	1 (9.1)	5 (16.7)
71-80	5 (26.2)	4 (36.3)	9 (30.0)
>80	6 (31.6)	3 (27.3)	9 (30.0)

The classrooms were generally overcrowded. Over 60% of the student teachers were teaching in classrooms where there is a minimum of 70 students per classroom. Large classes interfere with the effective utilization of all teaching methods. Reducing the class size in the coming decades is also unthinkable owing to the extreme low level of developing countries economy.

There are some attempts to test techniques of teaching in large classes. Engida (1993) investigated the relative impact of teaching chemistry by ‘instructional functions approach’ on student achievement in such classes. This approach is described in Rosenshine and Stevens (1986). Three 11th grade classrooms in each of the randomly selected 8 government and private high schools in Addis Ababa were used. The 24 regular chemistry teachers were assigned randomly but equally to treatment observed (TO), treatment unobserved (TUO) and control observed groups (CO). The approach was experimentally tested using this “pretest-posttest control group” design on the content area “chemical equilibrium” on 1735 students. It was then observed that the experimental treatment worked very well and brought significant differences between treatment and control teachers in both types of schools. The instructional treatment, when implemented, also had a large positive impact on student achievement.

The importance of particular variables in the approach such as asking questions during presentation and feedback can be enhanced if teachers focus more on eliciting higher order responses than on mere recall of specific facts. To this effect, teachers should include critical and creative thinking questions in class discussions and on tests (Engida, 1997).

Employing meta-cognitive strategies by verbalizing questions' teachers ask themselves about ways to solve problems (Costa and Marzano, 1987) could also be a means to achieve this goal. One form of meta-cognive thinking called the think-pair-share technique (McTighe and Lyman, 1988; Engida, 1997) would also be of great help; it synthesizes the advantages of wait-time and cooperative learning. The technique has been employed successfully in large (about 100) college biology and physics classes (Carbone, 1998). Inquiry-oriented class discussions whose effectiveness in large classes has already been tested (Zoller, 1999) can also be a strategy towards helping our students develop such higher order cognitive skills. Of course, teaching in large classes particularly in African context needs further empirical investigations. But we can not delay helping our students be critical thinkers, effective problem solvers and decision makers!

The student teachers were also asked to describe whether they perceived differences in science teaching between what they have acquired theoretically and what they have actually seen through their practice. Taken all together, 43.3% of the subjects (see Table 2) recognized that there is a big difference between the knowledge they acquired in the University and their experiences about the "how" of science teaching. This discrepancy between theory and practice can be ascribed to at least three reasons. First of all, as currently practiced, the professional course that directly attacks the problems and strategies in science education lasts only for 9 - 10 weeks of the whole 4 years study time. It is therefore unrealistic to expect this theoretical course to be as effective as possible in addressing issues of science education in such a short period of time. Secondly, there are no courses for orienting student teachers with school-based laboratory experiments. What has been done, instead, is lecturing on such methods as "Laboratory Instruction, Inquiry/ Discovery Method", methods that are tested in the context of developed countries. They have never been experienced in any course even by the instructors themselves, let alone being examined for their relevance and effectiveness in the Ethiopian context.

Table 2. Student Teachers' Perceptions of Theoretical and Practical Knowledge

Differences Between Theory	Number (%) of Responses

and Practice in				
		Chemistry	Physics	Total
Science Teaching:	Big	9 (47.3)	4 (36.4)	13 (43.3)
	Moderate	4 (21.1)	3 (27.3)	7 (23.3)
	Little/No	4 (21.1)	1 (9.0)	5 (16.7)
	NR*	2 (10.5)	3 (27.3)	5 (16.7)

*NR= No Response

Even the borrowed pedagogy is only presented theoretically. Thirdly, all the other courses are presented to students in discrete form. The pedagogical courses are not integrated with the subject matter courses. The former are presented to the would-be science teachers as they are presented to pure pedagogy students. The pure science courses are also presented to the would-be science teachers as they are presented, say, to the would-be industrial researchers. Thus the student teachers themselves are expected to integrate these two types of courses for themselves and become effective science teachers.

All student teachers mentioned lack of materials as one of the major discouraging factors in teaching the science subjects. This problem was also mentioned by some 125 (78%) of the regular chemistry teachers in Addis Ababa senior secondary schools (Engida, et al., 1996). As

Goodwin and Taylor (1999) put their experiences with Kenyan primary education:

"The lack of resources available to many Kenyan teachers in conventional terms, is out side of the experience of those of us familiar with even the poorest UK primary school"(p.9).

It is, as commented by the author of this article, "a perennial problem in most developing countries." At the same time, it is the most difficult one to solve under the existing economic conditions in these countries! It is hardly possible for the Ethiopian government to provide for the required amount of education budget of the secondary schools. There are about 1,378 junior and senior secondary schools as of 1993. Stated explicitly, "The financial allocation for the sector is still very low and will be far below the needs for many years to come. Government alone cannot possibly satisfy the demand for education and the private sector has to actively participate in this endeavor" (TGE, 1994: 9).

Our experiences, however, tell us that the private sector (if any) and international donor agencies are not that much interested in the area of secondary education. For instance, the major concern of the newly launched USAID project called BESO (Basic Education System Overhaul) is to improve the quality and equity of just primary education. On the other hand, production and delivery of textbooks, science kits and school furniture have been the sole responsibility of EMPDA (Educational Materials Production and Distribution Agency), which was established with the assistance of Swedish funds and personnel. Unfortunately, its department for the production of science kits “hardly reached the level expected of it. The distribution of science kits was extremely poor; level of production was limited to only one science kit per class with illegible users manuals and no spare parts” (Tekeste, 1996: 59).

It is under such circumstances that the Ethiopian (African) students are being trained to be “effective” science teachers! In spite of all such obstacles, the science educators should seek alternatives to alleviate the problems. Providing solutions to these problems is by itself a challenging research task that requires the collaboration of professionals in various fields such as basic science, technology, science education and even educational policy development and analysis. At this point, however, priority areas could be highlighted. Which resources are available in the immediate surroundings of the schools? To what extent has basic research in science and technology investigated the local (African) resources? How can their use be maximized? Are there efforts on the part of Ethiopian (Non-western) science educators to develop and validate teaching strategies (models): a) whose implementation is primarily based on the use of local materials? b) whose theoretical bases are the investigation of indigenous knowledge? c) which can successfully be applied in large classes with limited resources? Can we, simply because of our large classes and limited resources, continue with our traditional method of imparting knowledge (lower order cognitive skills) to students and still live as an essential part of the coming century? Are there science education policies that guide the organization, development and implementation of such tasks? Are the professionals ready both intellectually and attitudinally to carry out reforms in African science education, or should such programs be still left aside as minor priority areas? In what respect and how could we learn from the experiences of the developed nations? Etc.

Table 3. Student Teachers' Responses about the Major Areas of Supervisory Comments Given to Them by the Cooperating (Supervising) Teachers

Major Areas	Number (%) of Responses		
	Always	Sometimes	Never
A. Factual Accuracy	17 (56.7)	9 (30.0)	4 (13.3)
B. Lesson Planning	14 (46.7)	9 (30.0)	7 (23.3)
C. Selection of Methods	10 (33.3)	11 (36.7)	9 (30.0)
D. Teacher-Pupil Relationship	10 (33.3)	10 (33.3)	10 (33.3)
E. Classroom Control	8 (26.7)	9 (30.0)	13 (43.3)
F. Questioning Skill	6 (20.0)	14 (46.7)	10 (33.3)

The evaluation format lists some six major areas of assessment. Using these areas as items on the questionnaire (Table 3), it was found that at least one-third of the student teachers were never receiving comments related to classroom management, teacher-pupil interactions and questioning skills. The most frequent comments were on factual accuracy and lesson planning.

We realize that content knowledge is fundamental to science teachers, and many science teachers have ‘inadequate’ training in science disciplines (Lee, 1995). However, the ability to represent the subject to the students demands more than subject matter knowledge. Such a knowledge is just one aspect of teachers’ knowledge structure that consists of: general pedagogical knowledge, pedagogical content knowledge, knowledge of subject matter, knowledge of milieu, and knowledge of self (Adams and Krockover,1997). The supervision should thus be able to provide the student teachers with balanced feedback.

The University Subject Area Methods’ Instructors Views

The science educators at the University stressed that there is no clearly illustrated teacher training model in the University. Because of this reason the kind of knowledge and skills expected from the trainees are not clear to the instructors, the student teachers, and the school supervisors. To the best of this writer’s knowledge this problem is the core of the issue. It is really disappointing that the student teaching program has been without any training model! The goals of the program, the implementation strategy, the very nature and philosophy of the school-university relationship and the supervision issues (Engida, 1995) should all have been guided by the model. Thus the science educators should first work on it. To this effect, considerations should be made to the priority areas mentioned earlier in this paper.

Most of the professional courses, the instructors admitted, are not skill oriented courses. Student teachers are told only through lectures what the skills are and how they may be used. It is however hardly possible to help someone develop skills by simply presenting facts about the skills. We also realize that science teachers should have creative and critical thinking skills that help them investigate into the multitude of problems in African science classrooms. They should also be able to produce school graduates who can effectively employ their skills to earn their living in the least developed societies. Otherwise, there is little ground for African governments and parents as well to invest on secondary education. As Tekeste argues "... the experience of formal education in the rural and semi-rural areas [the majority] has not in any way contributed to either increased production or increased relevant knowledge" (1996: 45). Our secondary science education should thus seek means of defending itself. It should be able to contribute to the development of a strong (quality) general education. The key to this goal lies on the training of science teachers. Thus, there is a need to orient the education courses in the direction of relevant skill development. Encouraging science student teachers to creatively think about and critically investigate into scientific problems that pertain to the given society and environment should be unavoidable task of the science educators (Engida, 1997).

The lack of cooperation among relevant faculties for course design and implementation and the weak partnership between the University and schools are also problems. In any case there is a high tendency to believe only 'basic content' in one's own course is the most important. Such a tendency has resulted in insufficient amount of relevant input qualities in the program.

The Cooperating Teachers / Supervisors Views

Skill in supervision is an important factor for the success of the student teaching program. Our teachers however pointed out that they lack sufficient orientation and training about supervision. Maybe as a result, they concentrated on 'factual accuracy' as their major area of feedback to the student teachers. According to these teachers the science student teachers showed major weaknesses in most of the basic techniques of teaching. Motivation, questioning and explanation techniques were some of the examples. It seems logical, however, to expect such poor qualities from student teachers who were given the opportunity to stand in front of pupils only for one month in 4 years. They were also given little or no opportunity to observe how someone motivates, asks or explains to others!

The School Deputy Principals Views

The deputy directors identified the following as the major problems in implementing the student teaching program. (1) The secondary schools administer progressive tests in order to evaluate their pupils; the use of student teachers then affects such tests because their tests are not usually acceptable by the regular teachers, and they usually do not teach at the same pace as the regular ones do; this, in turn, affects the yearly plan of the schools. (2) When the student teachers are taking care of the classrooms, the regular teachers feel that they are totally free from their duties during that period and hence do not appear in the schools. (3) Since the schools are in short of the various teaching materials such as laboratory equipment, textbooks and dusters, the student teachers have been facing problems to secure these materials. One cannot underestimate such administrative issues while running student teaching programs. However, there seems little ground to reject the tests given by the student teachers as long as they teach and test under the supervision of the regular (experienced) teachers. If the student teachers are allowed to practise teaching, why not then evaluating? The two are inseparable components of the teaching-learning process! On the other hand, it is true that even novice and experienced teachers do not teach at the same pace! Had there been a clearly articulated partnership between the University and the schools, such given differences between the student teachers and the regular ones would not have been mentioned as excuses. All regular teachers that are replaced by the student teachers could have been engaged in post teaching seminars without creating administrative problems. The question is whether the teachers assume such science teacher development tasks as part of their professional duties!!

Conclusions and Suggestions

Student teaching has been an integral part of the Teacher Education and Training Program of the Addis Ababa University. It is, however, recognized that the program has weaknesses with regard to its design and implementation.

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                    University/ College
                  /                     \
                 /                       \
                /                         \
               /    Student Teachers       \
              /         of Science          \
             /                               \
            /                                 \
Schools   ———————————————————————————   Science Classrooms
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Fig. Levels of Factors to be Considered in Training Student Teachers of Science

The study also indicated that the problems are centered at three levels: University, School and Science Classroom. We also realize that every innovative student teaching program is the "product of a set of assumptions about knowledge, language, and expertise of school-based teachers relative to the knowledge, language, and expertise of university based teacher educators and researchers" (Cochran-Smith, 1991: 104-105). Thus, in training student teachers of science, the school-university relationship should be clearly defined and the factors at each level in the above figure should be given due attention. The figure shows that, throughout their professional development, the student teachers of science belong not only to the University -- as it is the case traditionally -- but also to the schools and the science classrooms. The personnel involved at each level should work as mutually constructed learning communities to help the student teachers investigate into the problems of the science classrooms. The student teachers should be helped at each level to contribute to the required science education reform by inquiring into their own teaching in large classrooms with limited resources. However, the link should not be limited to just 1 month of the final study year.

Rather, the 4 years of study time should also be a time for acquiring school experiences.

At the University/ College Level

The instructors of all the relevant courses should first of all believe that they are trainers of science teachers! They should abandon the philosophy: 'basic content in My Subject is the most important'. They should realize that the consequence of such a philosophy is just imparting facts and concepts to those who cannot use them later. Instead, they should think that 'the most important is to see My Student being a real Science Teacher in Our Classrooms!'. Mere reduction of the contents of the courses for the non-teaching stream students would not suffice for preparing science teachers. The courses for the latter group should clearly reflect the practical realities in our schools and classrooms. The science courses should be culturally sensitive and should not simply be a collection of basic facts about the western science. Mere transfer of the western science, experience tells us, would have little contribution to our students' understanding of their real world! The science educators should also focus on identifying, developing and testing strategies that can effectively be utilized in

African classrooms. The aim here is to help pupils leave secondary schools with certain basic skills, skills that can be utilized in the immediate environment, in an African culture. Our secondary science should be able to contribute to the productive capacity of the general education graduates. A secondary education system with an annual out-put of more than 70,000 unemployed school-leavers should not be allowed to continue doing that any more!

At School Level

It would be a futile attempt to reorganize the science education programs just at universities without considering school related administrative issues. The principals/ deputy principals of the schools should consider the training of science teachers as part of their duties. The administrators should also strive for equipping their school laboratories with reasonable materials. Encouraging the school science departments to actively work on developing and using locally made materials should be their major task. They should show great efforts to organize activities that would generate funds for these purposes. Rewarding creative works of teachers and pupils would encourage investigation of the school environments.

Although the Ethiopian education is highly influenced by an examination oriented system (Bekele and Engida, 1992), the schools should fight against the principle of only preparing students for examinations. The last decades confirmed that, each year, more than 90% of the school-leavers are simply swimming in the world of unemployment and crime. Thus, schools should strengthen their relationships with the Universities and Colleges to alleviate these problems. The school administration team should strive to make the school a teaching and research center. The school's research 'policy' should primarily focus on the investigation and efficient utilization of the immediate environment and local materials.

At (Science) Classroom Level

At this level the science teachers should consider themselves as trainers and researchers. It is the belief of this writer that if science teachers recognize themselves as researchers, then the student teaching program would be a very fertile and ready-made data source. Teachers can analyze the day to day teachings of different student teachers; they can immediately recognize the pros and cons of various techniques in a naturalistic setting (the large-sized classroom as it is organized for administrative purposes); they can develop and test teaching materials with the help of fresh assistants (the science student teachers); they can reflect on their own long years of 'teaching' experiences; and hence they can contribute to the development of the nation's science (education). The aim here is that the regular science teachers themselves learn teaching through their own investigative teaching. Thus, as researchers, their primary concern should be on the effective utilization of locally made materials in large classrooms. Of course, it would be a challenging and hard work; but the outcome is interesting and rewarding! As trainers, they should help their student teachers improve their lectures with interactive techniques, develop the culture of 'teaching as research' and concentrate on skill development.

The Student Teachers of Science

Last but not least, the student teachers should show commitment and willingness to be science teachers. Throughout their education and training they should investigate into the problems of school science whenever they conduct small scale research and write senior essays. They should give priority to the teaching and learning of the specific science subjects, and be able to reflect on what they experience at the three levels mentioned above.

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