Review

Practical Activity in Ethiopian Secondary Physical Sciences: Implications for Policy and Practice of the Match between the Intended and Implemented Curriculum, Samuel A. Bekalo and A.G. Welford (2000), **The Ethiopian Journal of Education, XX, 2, pp. 91-133**.

Reviewed by
Temechegn Engida*

Bekalo and Welford (2000) analyzed the old Ethiopian Physics and Chemistry curriculum materials and their implementations in 1995, although they claimed - perhaps unknowingly - that their paper "describes the present Ethiopian secondary physical science curriculum through its published materials..." (p. 94). The paper was originally published in **Research Papers in Education, 15, 2**, and reprinted in the **EJE** by "request of Samuel Bakalo, one of the authors" (p. 91). Whether the paper deserves reprinting would be judged by the readers of the article and this review.

The authors raised interesting issues in the form of concluding remarks, most of which were also realized in the last decade by many researchers (Abebe and Temechegn, 1992; Esayas, 1997; Mekuanent, 1992; Temechegn, 1991, 1992, 1993, 1997, 2000; TGE, 1994; Berhanu, 1996). However, the article had certain problems with regard to three points: conception of practical work, analytical procedures, and constraints to practical work. These problems, in turn, may have led the authors to unwarranted arguments and conclusions.

---

*Assistant Professor, Department of Curriculum and Instruction, Faculty of Education, AAU.

Conception of Practical Work

Bekalo and Welford defined practical work as "... an activity that promotes active learner participation in learning" (p. 95). They further stated that the activities ranged from 'hands-on' to student-teacher interactions. According to this conception, practical work seemed to be equivalent to all learning experiences students encounter in school curricula. If that was so, there would be little justification to use the word 'practical' as synonymous with 'all learning experiences'. Moreover, active learner participation in learning would be limited neither to science education nor to practical work. In principle, all child-centered approaches, irrespective of subject area, require the learner to actively involve him/herself in the learning process.

Although the authors advocated a too broad conception of practical work as "active learning", they failed to be consistent in their conception and hence began to differentiate active learning from practical activity by saying: "how the intended curriculum in science articulated its objectives with respect to active learning and the promotion of practical experiences, ... " (p. 97). It seems that it was this differentiation, and not their original definition, that helped Bekalo and Welford concentrate only on the analysis of "the practical activities on offer" (Ibid.) in the science textbooks.

Supporting their conception, however, Bekalo and Welford (p. 96) argued that:

> there is a need to design appropriate curriculum and instructional strategies which allow pupils to experience a range of problems that generate the conceptual and procedural knowledge demanded both in and out of classrooms. Practical work [as] defined here forms the basis for this kind of curriculum.

True, science students need to develop conceptual and procedural knowledge. The point, however, is that practical work alone is unlikely to generate all types of knowledge students are expected to acquire in a typical science curriculum of even the western schools, let alone the developing ones. Practical work should be viewed as an important and essential ingredient of science education, and

> if one accepts the need to offer a balanced curriculum in terms of content and process (Ausubel 1968), theory and practical work (Woolnough and Allsop 1985), and declarative and procedural knowledge (Lawson et al. 1989), the question remains about the optimal proportion of time that should be allocated to practical work (Tamir, 1991: 15).

Recognizing the detrimental effect that theory imposed on practical work could have on the development of scientific investigation skills, Woolnough and Allsop recommended to:

> stop using practical as a subservient strategy for teaching scientific concepts and knowledge since there are self-sufficient reasons for doing practical work in science and neither these, nor the aims concerning the teaching and understanding of scientific knowledge, are well served by the continual linking of practical work to the content syllabus of science (in Tamir, 1991: 15).

Analytical Procedures

In Bekalo and Welford's paper, as one of the analytical procedures, "each chapter in the textbooks and guides was taken as the unit of analysis, the practical activities on offer were noted and classified into different categories" (p. 97). Two points should be noted from this procedure: 'each chapter' and 'practical activities on offer'. The implication is that if no practical activity is offered in a given chapter, then that chapter will not be analyzed. (Note that this approach also makes clear the limit of the conception of practical work, unlike the authors' definition).

Using the above mentioned analytical procedure, Bekalo and Welford analyzed the old "Grade 10 and 11" (p 97) curriculum materials for Physics and Chemistry. If we took, for instance, the grade 10 Chemistry Textbook (MOE, 1989), we would find that there are three chapters to be covered in one school-year. However, practical activities are offered only in one of the chapters—the third chapter. This implies that, in reality, only this last chapter was analyzed in terms of the criteria adopted by the authors, and that these criteria did not have any relevance or were not appropriate to two-thirds of the material selected for analysis. The authors thus should have selected a different and appropriate unit of analysis like the 'page' in which practical activities were offered.

Constraints to Practical Work

Bekalo and Welford pointed out that the focus of their paper was "to comment on constraints on the development of practical work in school science" (p. 96). Because of this statement of purpose it was imperative to reflect on the kind of constraints identified by the authors. And since the authors stated that their sources of data "included published and unpublished documents" (Ibid.), the reviewer made some reference to those published and unpublished research work but not necessarily those mentioned by the authors.

The authors argued that:

> ... lack of equipment and resources is not always the reason that discourages teachers to use practical work. One of the sample schools and both the teacher-training colleges visited were reasonably resourced and had fewer than 20 students per class (p. 119).

One may not need to be a science educator to comment on the above arguments; being an African in general and an Ethiopian in particular (of course, living in Ethiopia) is a sufficient condition to do so. In general, two cases could be identified with regard to the arguments:

- either the authors observed a classroom in which there was a great deal of absentism, for one or other reasons, or
- the classroom was a self-created ideal classroom which helped to conclude that the Ethiopian science teachers and educators did not have knowledge and experiences about practical science, which Bekalo and Welford experienced in western schools and universities.

Whatever the case may be, the reality is that "the institutions of higher learning are generally overcrowded, underfunded and unsatisfactorily equipped resulting in the deterioration of the quality of their training and their research capacity" (TGE, 1994: 7). Moreover, in a workshop conducted from 3 to 4 July 1995 and in which the first author (Bekalo) had the chance to attend, Gebru and Belay (1997) reported that the number of pupils in which science student teachers of KCTE were assigned ranged from 54 to 105, with a mean value of 72.58. Temechegn (2000) reported the same class-size in connection with Physics and Chemistry student teachers of the 1996/97 academic year in AAU. Although the current academic year (2000/01) chemistry student teachers in AAU were exposed to detailed school-related practical activities with the help of two guest German Professors of chemical education, the student teachers faced the same problems like those reported in Temechegn (2000) in implementing practical activities in our schools.

The developed nations too agree that developing countries have resource deficiencies. Several attempts have also been made to provide solutions to these problems. Allsop (1991), for instance, discussed four different ways of providing resources and equipment for practical science in low-income countries. The first approach was 'improvisation by teachers', which was a creative activity although very difficult to realize in low-income countries where teachers were unreliably paid (Ibid.).

The second one was 'in-service workshops for equipment production', which was attempted in Ethiopia. In one workshop participants were drawn from chemists working in different Teacher Training Institutes, Secondary and Technical Schools, Teacher Training Colleges, Faculty of Education (AAU), Awraja Pedagogical Centers, the Chemical Society of Ethiopia, and the Ministry of Education (MOE). The workshop finally produced a sourcebook—Ethiopian Chemistry Teacher's Sourcebook: Volume 1, Models and Materials (Amha et al., 1991)—which stated that the sourcebook:

> ... is a book of ideas for better teaching, learning and assessment through practical doing. It offers suggestions on how to teach practical chemistry with locally available materials and resources. ... All the materials described have been devised, constructed and tested during the pilot workshop. Most of them can be constructed at low or even no cost with a few tools and materials by the technically untrained (p. iii).

Another workshop was also conducted by the Subject Area Methodology Unit of the Department of Curriculum and Instruction (AAU), in cooperation with the Ministry of Education and the German Cultural Institute, on the theme "Improving Experimental Physics Instruction at Senior Secondary Schools" (Esayas, Goertler and Temechegn, 1992). Among other topics, the workshop emphasized 'practical activities in preparing experiments and demonstrations in groups' in actual classrooms of the Addis Ababa Schools.

Although this is the reality in our schools, Bekalo and Welford argued that:

> ... there is an assumption among Ethiopian science educators, including teachers, that practical work in the sciences means laboratory work involving relatively sophisticated and imported expensive apparatus. Alternative practical activities, such as those that can be done outside the laboratory or with locally available materials are not considered to be practical work; they are also perceived as low status activities (p. 93).

While the above-mentioned source book (which is also listed as a reference by Bekalo and Welford) reminds us that the Ethiopian science educators and teachers have attempted to use locally available materials for implementing practical science since the last ten years, it is really astonishing that some outsiders to our educational system like Bakalo and Welford tell us that we perceive such approaches as 'low status activities'!

The financial constraints also inhibited the use of both 'nationally produced equipment' (by EMPDA) and 'imported equipment' that Allsop (1991) identified as the third and fourth alternatives. If the authors want to know more about the constraints in teaching practical science in Ethiopian secondary schools during the previous regime, I suggest that they note the following points documented by the local science educators:

- Mekuanent (1992) argued that although the Biology textbooks were overall good seen from the point of view of the enquiry approach, they aggravated the already delicate problem because of the total number of activities included, amount of time required for their completion, amount and quality of materials and equipment needed for their implementation, and amount of content to be covered (especially in grade 11).

- Temechegn (1991, 1992, 1993) analyzed the senior secondary school Chemistry curricula (grades 9-12) and their implementations in our classrooms from different perspectives. He found out that i) while more than 50% of the behavioral objectives in the curriculum guides dealt with the knowledge category of the Bloom's cognitive domain, only 39% of the practical activities in the Chemistry texts belonged to this category; ii) no objective in the guide was formulated to promote the student's evaluative capacity in the cognitive domain, whereas 15% of the practical activities dealt with this category; iii) while the curricular objectives were designed to foster mostly lower order cognitive skills (LOCS), there were substantial percentages of higher order cognitive skills (HOCS) in the practical activities included in the texts (83 practical activities organized under 40 major chemistry topics in grades 9-12); iv) most chemistry teachers did not have access to the curriculum guides and every teacher was engaged in teaching the lessons with no reference to the curriculum guides; this resulted in a big gap between what was intended to be taught and what was actually taught; v) both the contents and activities in the textbooks contained little elements of inquiry; more specifically, out of 21 levels in the Klopfer's table of specification for inquiry, only 9 levels were found in the chemistry textbooks.

- Esayas (1992), after comparing the lecture method with the lecture-demonstration method for low and high achievers, found out that i) the low achievers benefited more from the augmented demonstration method, and ii) there was no difference in achievement associated with change in method of teaching for high achievers.

- The Transitional Government of Ethiopia (TGE, 1994) also documented the following points:
    - Though the paper qualification of teachers at all levels improved over the years, a significant number were still inappropriately and inadequately trained for the level they were teaching. Only about 40% in senior secondary schools had appropriate certification for this post.

    - The preparation of teachers starting from recruitment right through the actual training to the quality and competence acquired at the end was unsatisfactory It would be unrealistic to expect a satisfactory standard of education with the crucial players being in such a state of affairs.

- Berhanu (1996) argued that in the grades 9 and 10 physics curriculum i) the science process was not considered as another independent entity of science education, and ii) there was no specific time allotted for practical teaching besides time allotted for the content -based teaching.

The reviewer believes that the above mentioned local reports reflect the constraints of science education during the former Ethiopian regime more than Bekalo and Welford's paper!

References

Abebe Bekele and Temechegn Engida (1992). *Relationships Between the School Curricula Designers and National Examination Writers.* A Research Report, **Institute of Educational Research** (with the financial support of FINNIDA), Addis Ababa University.

Allsop, T. (1991). *Practical Science in Low-income Countries.* In B. Woolnough, **Practical Science**, pp. 31-40. Milton Keynes: Open University Press.

Amha Bekele, Atrsaw Tasew and Mulugeta Nega (1991, eds.). **Ethiopian Chemistry Teacher's Sourcebook, Volume 1: Models and Materials**. Addis Ababa: EMPDA.

Berhanu Habtemariam (1996). *Practical Physics in Ethiopian Secondary Schools: Conceptualization and Organization of Practical Activities in Grades 9 and 10—Review and Implications for Future Planning.* M.Ed. Thesis, **School of Education**, University of Leeds.

Esayas Belay (1997). *Inquiry Skills: Description and Significance in Teaching Science.* In Proceedings of the First Science Workshop of Kotebe College of Teacher Education, Addis Ababa 3-4 July 1995, pp. 97-102.

_____ (1992). *Teaching Concepts of Physics Through Demonstration and Lecture: An Experimental Study on Low and High Achievers in*

Entoto School. M.A. Thesis, School of Graduate Studies, Addis Ababa University.

_____, Goertler, W. and Temechegn, E. (1992, eds.). *Improving Experimental Physics Instruction at Senior Secondary Schools*. A Book of Collected Experiments, Presented Papers and Discussions, Addis Ababa, 9-12 December 1992.

Gebre Behute and Belay Tefera (1997). *Reflections on Student Teaching Experiences in the Natural Science Department of KCTE*. In Proceedings of the *First Science Workshop of Kotebe College of Teacher Education*, Addis Ababa 3-4 July 1995, pp. 103-134.

Mekuanent Kelemu (1992). *An Evaluation of the Teaching of Biology in Some Selected Senior Secondary Schools of Addis Ababa Vis-a-Vis an Enquiry Model*. M.A. Thesis, School of Graduate Studies, Addis Ababa.

MOE (1989). **Chemistry: Grade 10**. Addis Ababa: EMPDA.

Temechegn Engida (2000). *Student Teaching in Non-western Science Classrooms: Analysis of Views from Potential Participants in the Program*. **Journal of Science Education**, 1, 2: 86-93.

_____ (1997). *World Trends in School Chemistry*. In Proceedings of the First Science Workshop of Kotebe College of Teacher Education, Addis Ababa 3-4 July 1995, pp. 206-215.

_____ (1993). *The Ethiopian Senior Secondary School Chemistry and Inquiry*: An Evaluative Approach. Paper presented at the 11th May Annual Seminar of the Bahir Dar Teacher's College, 22 May 1993, Bahir Dar.

_____ (1992). *Analysis of Elements of the Chemical Process Skills in Ethiopian Secondary School Chemistry Textbooks*. Paper presented at the 9th Annual Congress of the Chemical Society of Ethiopia, 10-11 August 1992, Addis Ababa.

_____ (1991). *An Investigation of the Chemistry Curriculum in Selected Senior Secondary Schools of Addis Ababa*. Paper presented at the 8th Annual Congress of the Chemical Society of Ethiopia, 9-10 August 1991, Addis Ababa.

Tamir, P. (1991). *Practical Work in School Science: An Analysis of Current Practice*. In B. Woolnough, **Practical Science**, pp. 31-40. Milton Keynes: Open University Press.