

SCIENCE NEEDS AFRICA AS MUCH AS AFRICA NEEDS SCIENCE (1) A CASE IN TANZANIA

Wolfgang Czieslik
Gymnasium am Mühlberg, Bad Schwartau, Germany
Email: wolfgang@czieslik.de

Hans-Dieter Barke
Institute for the Didactics of Chemistry,
Westfälische Wilhelms-Universität Münster, Germany
Email: barke@uni-muenster.de

ABSTRACT

From 2003 until 2012 we visited several secondary schools around Moshi (Tanzania) and Mwenge University College of Education near Moshi, a teacher college which was founded in 2001. During our visits we found that the schools and the college were lacking of material for conducting experiments in an appropriate way, and teachers as well as lecturers were not well trained to conduct chemistry experiments. We recommend measures to improve the quality of science education at schools and colleges as presented in this paper. [AJCE, 3(1), January 2013]

Introduction

“One hundred Chemistry experiments to avoid chalk and talk” this was the headline for the project we realized in spring and summer 2003. With small boxes containing all materials for 100 Chemistry experiments we trained science teachers from the Kilimanjaro region in the laboratories of Vunjo Secondary School how to conduct chemistry experiments at Secondary Schools.

Science teaching in Tanzania – some personal impressions

During our stay in Tanzania in 2003 we observed lectures in some secondary schools, discussed with teachers how to conduct science lessons and met the Vice Principal of St. Joseph’s Teacher College near Moshi which now is Mwenge University College of Education (MWUCE).

From our observations in schools and discussions with science teachers in 2003 we found

three main problems:

- The schools are equipped with laboratories for practical lessons but they are in a bad condition.
- The schools are lacking material for conducting experiments in an appropriate way.
- The teachers are not well trained to conduct chemistry experiments.

Background information of the partnership between GaM and Tanzanian schools

In 1992 Gymnasium am Mühlenberg (GaM) in Bad Schwartau (Germany) and Vunjo Secondary School (VSS) near Mwiika (Tanzania) established a partnership which is based on

- regular exchange of letters between individuals (pupils, teachers) and also the committees of both schools
- mutual (exchange) visits
- the realization of different projects

From 2003 to 2005 three workshops for science teachers from the Kilimanjaro region have been realized at Vunjo Secondary School. The teachers mainly have been trained how to use experiments and models in chemistry, physics and biology lessons.

During our stays in Tanzania we visited Mwenge University College of Education (MWUCE) near Moshi and were asked to offer those workshops also for the college.

These observations are valid all over Tanzania and not only for the small number of schools, we visited. In connection with this problem Hamilton and co-authors found in 2010 with their study on the needs of science education in Tanzania (2, p. 12):

- “Resources are lacking in most every aspect of education, including insufficient numbers of qualified teachers of mathematics and science at the primary- and secondary-school level, inadequate equipment and materials, textbooks and facilities (i.e., laboratories and libraries). While resources needs are greater in rural areas, only a fraction of the needed resources is available in most every school in the country—regardless of the region.
- The quality of teaching is inadequate to meet the learning needs of students at all levels, in several respects. First, many primary school teachers lack the minimum academic qualifications — generally and in their subject matters in mathematics and science—to perform competently in the classroom. Second, teachers at both the primary- and the secondary-school levels are not well trained in the use of appropriate pedagogies. Whereas most teachers surveyed do know and report applying some context-based approaches, student performance in mathematics and science reflect neither thorough subject-matter knowledge nor adequate knowledge/application of the competency based approaches that are the basis of the science and mathematics curricula. Third, university students, employers and other participants in the study all report that education in mathematics especially—as well as science—do not provide graduates with the knowledge and the ability to apply it in the workplace. Fourth, while the teacher preparation curricula do, at the primary-school level, incorporate learner-centred approaches to teaching and assessment, the structure, organization and implementation of teacher preparation programmes are lacking in this respect. A complete assessment and overhaul of the current teacher preparation system is

needed, especially at the primary-school level, where children's formative experiences with learning in mathematics and science have far-reaching effects upon students' attitudes, knowledge and skills development."

At Secondary and high schools in Tanzania practical tasks are an obliged part of the governmental examination in chemistry, physics and biology. To fulfil this requirement it is necessary that students are trained to do science experiments by their own and the teachers have to be trained how to conduct chemistry experiments in school lessons. Additionally the school laboratories have to be ready for doing experiments in the classes.

Teacher training workshops, as we practised them between 2003 and 2005 at Vunjo Secondary School for science teachers from the Kilimanjaro region have been successful and the teachers told us that they profited very much from this work. In the following years from 2003 we noticed from discussions with teachers at secondary schools and lecturers at Mwenje University College of Education that teacher training alone is not enough. The student teachers leaving the college with a Bachelor degree are educated in Chemistry but they were not trained to conduct chemistry experiments at Secondary schools in a suitable way.



Prof. Dr. Hans-Dieter Barke talking with students from MWUCE about models

To minimize the problem of teachers with few or no experiences in conducting chemistry experiments, it is necessary to train pre-service teachers at Colleges and Universities in this field.

From our visits and discussions we know that this training only can be realized when the qualification of the lecturers is improved.

In spring 2012 we did the first step to reach the described goal when the principal of MWUCE asked for an expert in the following fields:



Dr. Wolfgang Czieslik talking with students from MWUCE about experiments

- Show the college lecturers, the students and some secondary school teachers how to conduct good chemistry experiments.
- Collaborate with them to develop experiments suitable for chemistry lessons at Tanzanian secondary schools and high schools.

In autumn 2012 the authors went to Tanzania to do the very first step fulfilling the given tasks. They took over lectures and workshops on models in chemistry, misconceptions and motivating experiments. Students and lecturers got an insight into latest results of research on using models in Chemistry and on misconceptions of secondary school students (3-4). We performed various experiments with different didactic functions which could be done with materials which are available in every laboratory. In addition to our performance of lectures we visited some Chemistry lectures and found that they did not meet all requirements of a University College.

The laboratories and lecture rooms were ready for groups of different size without using media like overhead projector or beamer. Overhead projectors and beamers, which were available on demand, could not be used at any time because of breakdown of electricity.

The Department of Chemistry has two Chemistry laboratories with basic equipment (e.g. flasks of different form, beakers, measuring cylinders, stands, Bunsen burners, balances and chemicals) which is required for almost basic experiments. Higher demanding experiments according to the standard of a College cannot be done. The laboratory was in a bad condition and it was very hard for the students to do their practical work according to a standard required for a college.

RECOMMENDATIONS

Hamilton and co-authors recommended based on their findings (2, p. 45) to:

- Establish and strengthen an effective system of teacher preparation, including pre-service and in-service training components at both the primary- and secondary-school level. This system would emphasize the use of context- and inquiry-based instructional methods in science and mathematics.
- Establish partnerships between Tanzanian industry, science and technology colleges and universities and similar institutions abroad. These partnerships could include advisory boards, activities for knowledge and technology exchange, workshops and student- or teacher-led action research projects to improve the quality of education in science, mathematics and technology.

As a consequence of our findings at MWUCE and at some secondary schools we suggest specific measures as follows:

- Redevelopment and reorganization of the chemistry laboratories according to the standards adequate to a college. Only if the laboratory is well equipped and well managed that qualified practical work can be done by the students.

- To improve the quality, the lecturers have to be trained on modern concepts of chemistry and how to perform chemistry experiments at the College and secondary schools. We suggest organizing a one week local congress for lecturers and teachers on science teaching in summer 2014. This congress will be organized in cooperation with German and African Universities, especially with the Federation of African Societies of Chemistry (FASC).

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