TuWaS! IN GERMANY – FIBONACCI IN EUROPE: PROGRAMS SUPPORTING INQUIRY-BASED SCIENCE EDUCATION IN PRIMARY SCHOOLS

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ABSTRACT

TuWaS! (Technik und Naturwissenschaften an Schulen, Technology and Science in Schools) is a program to promote inquiry-based science education (IBSE) in primary schools in Germany. It was founded in 2007 as a cooperation between the Freie Universität Berlin and the Berlin Brandenburg Academy of Sciences and Humanities as a result of the success of the Pollen project. Pollen was a European research and development project supported by the European Commission (6th Framework Program), aiming to stimulate and support science teaching and learning in primary schools in 12 European “Seed cities”. TuWaS! is based on five pillars: (1) professional development of teachers, (2) providing teaching material, which is (3) curriculum based, (4) the involvement of the community and (5) assessment. In the five years up to 2012, TuWaS! has trained over 1000 teachers and serves over 170 primary schools in four different German states. Within the Fibonacci project, which is another project funded by the European Commission (7th Framework Program), TuWaS! cooperates with three countries: Luxembourg, Austria and Turkey.

Keywords: Inquiry-based science education, IBSE, Fibonacci, Pollen

Introduction

TuWaS!, a program to support inquiry-based science education (IBSE), existed in its present form because the European Commission provided the seed money through the 6th Framework Program to fund the project Pollen. This seed money was followed by money from other stakeholders and community members (see section “Think big and look for partners: Community support”). Another reason for the success of TuWaS! was the opportunity to learn from partners within the Pollen community and outside. These include the Pollen partners La main à la pâte from France and the Naturvetenskap och Teknik för Alla program (NTA, Science and Technology for All) from Sweden, as well as partners from the USA: the National Science Resources Center (NSRC) and AMSTI (Alabama Math Science and Technology Initiative). The section “The beginning: responding to the needs of teachers and schools” acknowledges the work of these partners and shows that a program can benefit through “twinning” with an experienced partner. The idea that a program can benefit and accelerate through “twinning” with an experienced partner is part of the Fibonacci project which was supported by the European Commission in the 7th Framework Program. Within Fibonacci, TuWaS! cooperates with other
countries such as Luxembourg, Austria and Turkey in which TuWaS! held professional training workshops. In addition, Fibonacci helped strengthen the collaboration between TuWaS! in Berlin and TuWaS! in Cologne/Bonn.

The beginning: responding to the needs of teachers and schools

In 2005, the Berlin school system added the new subject “science” in grades 5 and 6 and increased the number of topics concerning science and technology in grades 1 to 4. These changes were difficult for the schools to implement. The majority of primary school teachers had not studied science and was afraid to teach it. Also most schools were and still are not properly equipped. Many do not have special rooms to teach science and lack the materials for hands-on science activities. The time was ripe for a program that would support these teachers to enable them to teach the new curriculum.

When visiting a primary school in Linköping, I was introduced to the NTA program (Naturvetenskap och Teknik för Alla, Science and Technology for All) and realized that such a program could help teachers in Berlin. In the process of finding funding for such a program, the Freie Universität Berlin was invited by La main à la pâte to join the European funded project SciencEduc, as an associate partner.

Within SciencEduc, the Freie Universität Berlin and the Berlin–Brandenburg Academy of Sciences and Humanities held a conference in September 2005 called “Science is primary”, which included an inquiry workshop for primary teachers. As a result, 21 schools applied to take part in Pollen, the follow-up EU program. The aim of Pollen was to support inquiry-based science education in 10 primary schools in each of the 12 participating countries, each country developing its own strategy to reach that goal. Since Pollen could not serve all interested 21 schools and to sustain the project beyond Pollen, TuWaS! – Technik und Naturwissenschaften an Schulen (Technology and Science in Schools) was founded by the Freie Universität Berlin and the Berlin – Brandenburg Academy of Sciences and Humanities in 2007. “TuWaS!” translates to „DoSomething“.

TuWaS! is based on five pillars: (1) professional development of teachers, (2) providing teaching material which is (3) curriculum based, (4) the involvement of the community and (5) assessment (see Fig.1).

Figure 1. TuWaS! is based on five building blocks: professional development of teachers, providing teaching materials for teachers, which is based on the school curriculum, the involvement of the community and assessment. The idea of these five building blocks is derived from the National Science Resources Center (NSRC) and EU project Pollen.
Learn from others and share: teaching material and professional development

In order to implement IBSE in the schools as quickly as possible TuWaS! adopted many characteristics of the Swedish NTA program. Thus we choose not to develop our own teaching material, but to use already existing commercial teaching materials that were developed by the National Science Resources Center (NSRC). A number of reasons supported this decision. Most of the 24 topics available fit the German curriculum. It was pedagogically appropriate and it allowed a buildup of conceptual understanding over several lessons. The material focuses on inquiry, was field-tested in the USA and had been implemented in Sweden. Each unit includes enough experimental material (consumables and non-consumables) to allow 30 children to experiment for up to six weeks and a guide for the teacher. With Swedish help, the Freie Universität Berlin got a contract that allowed TuWaS! to translate the teaching material and adapt it to German schools. This adaptation process was performed by teams that included both primary teachers and scientists. So far, we have adapted 10 topics (Weather, Solids & liquids, Comparing and measuring, Life cycle of butterflies, Plant growth and development, Electrical circuits, Chemical tests, Motion & design, Microworld and Food chemistry). Like the Swedish NTA program, TuWaS! established a material center that rents the teaching materials to schools for five month. The materials picked up and refurbished the consumable material in the summer and winter breaks.

In order to efficiently implement a professional development program, TuWaS! invited trainers from Sweden and from the NSRC to run workshops in Berlin. Now TuWaS! offers day long workshop for each of the 10 topics. The workshops are run in the best case by two people one being a primary teacher the other being a scientist. Within a workshop the teachers perform the same experiments as their pupils will do later in school. After completing the workshop for a particular topic, the teacher can rent the material for a fee. This material includes everything that is necessary for the planned experiment or lesson, thus freeing up the teacher for the teaching, not needing to spend precious time shopping.

In addition to the topic workshops, TuWaS! is developing workshops that focus more on topics like “How to use a notebook” or “How to combine science lessons with improving language literacy”, again learning from other programs, such as AMSTI (Alabama Math Science and Technology Initiative).

Think big and look for partners: community support

When TuWaS! started in Berlin, our Swedish mentors told us to think big because the program might grow faster than expected. This was a warning; we did not pay enough attention to, but we should have.

An idea we took very seriously was the Pollen idea to involve the whole community (Fig.2). In order to spread the cost of the program, TuWaS! tried to diversify its supporters. This is important because a program with only one main supporter can collapse easily. Also, different supporters bring different types of skills, knowledge and support to the program. Support does not always mean money.

The cofounder of TuwaS!, the Brandenburg Academy of Sciences and Humanities provides the knowledge and support of its renowned scientist and has political connections. The academy also hosted two conferences concerning IBSE. Since its founding, TuWaS! was also
supported by the TSB Technology Foundation Berlin, which funded teaching material for technology topics and provided the salary for the head of the material center. In addition, the TSB Technology Foundation helps to promote TuWaS! in the community. One other extremely important supporter is the Senate Department of Education, Youth and Science. They funded the purchase and refurbishment of teaching materials. In addition, they allow teachers to work part time for TuWaS!, while being paid by the school system. They also contribute with their knowledge of the school system.

Figure 2. TuWaS! is supported by numerous stakeholders of Berlin. Figure modified after a figure developed for Pollen

TuWaS! is also supported by companies. For example Go! EXPRESS & LOGISTICS (a company that is specialized in the secure transport of time-critical shipments) delivers the teaching material to the schools and also pick them up for refurbishment without charge. Companies also helped to buy some of the teaching material. The Berlin chapter of the Junior Chamber International provided funds to pay for professional development. In addition, young volunteers (Freiwilliges ökologisches Jahr) work in the project by helping to refurbish the material and organizing public events.

Learn to share what you have learned: expanding and dissemination

In order to increase the number of children benefitting from TuWaS!, TuWaS!-Berlin assists others who want to implement a similar project. The new projects have to follow the concept of TuWaS! in order to be helped. They have to make the professional training mandatory before giving the teaching materials to schools, and they have to assist the schools when problems arise. But we allow also some adaptation to local conditions.

The Chambers of Industry and Commerce in Cologne and in Bonn Rhein-Sieg asked their members whether to start a project in North Rhine-Westphalia (a federal state within Germany) to promote science education in primary schools. After a positive vote, a number of possible programs were considered and TuWaS! was chosen as the model. The Chambers of Industry and Commerce provided seed money and asked their member companies for financially support of particular schools. The seed money funded half a position to transfer knowledge from Berlin to North Rhine-Westphalia and to coordinate the program. In addition, the initial professional development workshops and the teaching materials were also funded.

Through fundraising activities, numerous companies, business-related foundations and business clubs were convinced to adopted schools. The companies include 16 large companies

In contrast to Berlin, the schools in the Cologne/Bonn area do not have to pay a fee to get the teaching material. So far all the professional development workshops are run by experienced trainers from Berlin and the teaching material is refurbished in Berlin, but in the future local trainers will be recruited and a local material center will have to be developed.

\[ Figure 3. \text{Dissemination of TuWaS! within Germany and the stakeholder that were crucial in implementing TuWaS! in that particular German state.} \]

\( TuWaS! \)-Berlin also started to work in the federal states of Brandenburg and Hamburg. In Brandenburg TuWaS! is supported by the Association of the regional employers’ associations in the German metal and electrical industry. TuWaS!-Hamburg was initiated by the Landesinstitut für Lehrerbildung und Schulentwicklung (regional institute of teacher education and school development) and the Universität Hamburg.

\textbf{Lessons learned}

What are the important lessons we have learned from implementing and expanding TuWaS!: First, a program has to respond to the needs of the teachers and the schools, otherwise it will be hard to recruit the teachers. Secondly, it is important to learn as much you can from good role models, because it will speed up the implementation and growth. Do not forget to adapt to the local needs, which might differ from those of your role models. Programs grow faster than you might expect, thus look for partners from the beginning to get the work done.