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Playing Catch-Up in German Early Science Education with Science-Lab

Innovations Case Narrative:
Science-Lab

The poor results shown for German students in international studies that compared student achievement in various fields came as a shock to the different constituent groups in Germany, such as parents, educational professionals, and politicians. The German government has generally considered its education system superior to those of other countries, but German students' results in the 2000 Program for International Student Assessment, or PISA, were significantly lower than the mean of all participating countries in all three areas that were tested: literacy, mathematics, and science (Weiss et al., 2001). Immediately afterward, lengthy and emotional discussions started about the reasons for the poor results. One problem was the late start of science teaching in the German education system. In 2002, there was no science program in German preschools or kindergartens (henceforth referred to as kindergartens, since in Germany almost all children attend kindergarten from age three to six). In primary schools, science was only a small part of the curriculum and focused mainly on biological topics, like plants and animals, but also touched briefly on subjects like water, air, temperature, and even electricity. However, even countries with science programs and curricula in place for this age group face the challenge that science teaching for young children must be different from the higher education approach. It should be far

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more phenomena driven in order to help children understand their world and life experiences. This means, for instance, that the chosen topics connect with everyday life situations of children, that phenomena are looked at from different angles and not pressed into one science field (like physics or chemistry or biology), that the children are the owners of the learning process, and that the teacher takes the role of the facilitator in this process rather than being the source of knowledge and information. To be successful, professionals delivering science education to the young need a particular set of skills. Germany had neither an explicit science program nor the skilled professionals available when my partner Sonja and I started Science-Lab in spring 2002.

THE ACTORS

I was born and raised in East Germany and had a solid science education in the East German school system. Biology started in fifth grade, physics in sixth grade, and chemistry in seventh. The East German education system had many shortcomings, but when it came to science education its approach was very good. Teaching science to students in fifth grade for two hours per week, gradually increasing it to six hours for those in seventh through tenth grade and through twelfth grade for those who were university bound, gave students enough time to acquire science content and lab skills. At the same time, West Germany had a system in which students could select their subjects and thus could get away in the extreme with as little as two years of science education.

After finishing high school and working at a chemical company, I earned my master's and doctoral degrees in physical chemistry. After one year as a postdoctoral student at the University of Texas at Arlington, I started my industrial career at BMW in Munich. Before I founded Science-Lab, I had started a successful high-tech consulting company. Through my two children I got to know Sonja Stuchtey, who also had two children at that time and now has five. As we became friends, we shared many discussions about the education of children within this ever-changing and technology-driven time. Her background was in strategic management, and she had her own customer relations management company. When we started Science-Lab, we had a mutual understanding about quality and professionalism, and that everything we would do had to fulfill one purpose: it had to be for the benefit and the well-being of children. We agreed that our goal would be to do anything we could to support children in understanding their world, to broaden their horizons, and to offer them opportunities they might otherwise not have. Now, seven years later, our aim is as true as it was in 2002.

THE FIRST STEPS

The early steps of Science-Lab were inspired by our own oldest children, who were four years old at that time. Everybody who has children knows how many "why" questions they come up with each day and how curious they are to discover their

world. Our own children were no exception. As attentive parents, we wanted to support their process of discovery but also to leave it in the children's hands as much as possible. At the beginning, we randomly chose questions from those our children had posed and tried to help them find answers by letting them experiment with household materials and guiding them by asking questions. Our children were delighted, and soon we didn't have only our own children but also the children of friends and relatives joining our "science kitchen and garden lab." All of them expressed a lot of interest and were enthusiastic about our activities. At this time we already realized, however, that all of their parents had a higher education background, many of them in engineering or science. Therefore we were curious to see if the children's interest came from already having a somewhat informed lifestyle, or if at that early age the parents' occupation was basically irrelevant. We asked one of the local kindergartens with a mixed clientele if we could work with their students on one scientific phenomenon from their world in a 30-minute session. Our wish was granted, and we prepared a session about "the air around us."

Our afternoon session included 30 children. They were given the choice to play with any of the indoor or outdoor toys and games the kindergarten offered, or to attend our session. One child wanted to play in the sandpit, but everyone else wanted to join us. When we let the children use simple experiments to help them understand the phenomenon of air being there even when not visible, the children were totally engaged, and the time went by much more quickly than anyone anticipated. It didn't make any difference what background the children came from—they were all eagerly engaged in learning and exploring. This was most encouraging to us, and we hypothesized that children at this age are genuinely interested in science in the sense that they want to explore the world around them, no matter what cultural or family background they come from.

We noticed one interesting tendency even back then: the teachers of that particular kindergarten were extremely shy and went on to do other business rather than watching us working with their children. Only toward the end, when they realized how engaged their children were, did they start to come closer and have a more or less reluctant peek. I will come to the reasons for that later.

DEVELOPING THE CONCEPT

After those initial findings, we thought that every child should have the chance to experience science at an early age, and to do so in a way that suits their age and broadens their horizons. Ideally this should take place in kindergartens and primary schools, and what struck us most was that it just didn't happen. But what were the reasons it didn't happen? What was keeping science out of the classroom? Why were teachers in German kindergartens and primary schools reluctant to step into the fascinating world of science? In our eyes and with our background and experience, it was fascinating and rewarding to help children understand their world and to learn about their life in a fun and meaningful way.

We found this experience so compelling that we wanted to change the situa-

tion in Germany and expose children at a fairly young age to science phenomena that they could grasp and think about according to their own level of understanding. But who were we, two women with science and economic backgrounds and four young children, that we could tell professionals how they should do their job? Nevertheless, we immersed ourselves in the literature on education in general and science education in particular and started to develop a concept for how to explore a variety of science phenomena with kindergarten children. Through our previous professional work, we knew from the beginning what our most important criteria would be: the highest quality in science teaching, sustainability for the children involved, and for all the people who lived and worked with them. A one-time visit to a kindergarten wouldn't be enough; in order to change children's thinking and understanding, we would need to offer regular sessions to explore science phenomena that the children experienced in their worlds. That led us to develop our first science course for children four to six years old.

PROVING THE CONCEPT

After putting together a science course for kindergarten children, Sonja and I wanted to find out if what we were doing made any sense—if children would like to come to our class and whether they would benefit from a science course that wasn't just a one-time event. But how should we go about that? The only chance we had was to find children who would come voluntarily to a club once a week and explore their world with us. So, we rented a room and prepared our first series of science sessions. We also found a local newspaper that agreed to write five lines about the fact that Science-Lab was starting soon and that it would help children find answers to questions like, How is a rainbow formed? Our goal was to get a group of approximately 10 children together; we would ask their parents to pay a fee so we could cover the cost of the room and the babysitters who took care of our younger children while we were teaching. The effect was overwhelming. Our phones didn't stop ringing after the notice was published, and within a few days we had 24 children who wanted to join Science-Lab. So, instead of starting with one group of children, we immediately started with three. This gave us the chance to climb the learning curve even faster. In order to do so, we reflected on each lesson and looked for ways to improve our approach. The children were very enthusiastic and counted down the number of nights they had to sleep before they could come back. Several mothers told us that their children didn't want to go to birthday parties or even weddings if they were on a Science-Lab day. Indeed, all the children attended the 14 sessions we offered over the course of five months. Even more exciting was the fact that once the course was over, they wanted to come to the next one. Half-way into the first course, Sonja and I knew we had tapped into something that didn't exist in Germany before, and that it was something children and parents were equally enthusiastic about.

Clearly there was a demand for an academically sound, child-centered approach to give children the science-based "brain food" they needed. Many

German parents were dissatisfied with the programs kindergartens offered, which banned children from learning to read or write, even when the children were ready for it. Furthermore, the kindergarten teachers were not trained or ready to explore the children's world through a scientist's glasses, thus only a few teachers were able to support the children adequately. By now this has changed in many kindergartens, and we can proudly say that our work certainly provided the spark to bring about this change. However, many German kindergarten teachers still think the same as the one who told me back in 2002, "Don't make the kids get their high school degree in kindergarten. Let them have their freedom. They will experience the seriousness of life early enough when they go into first grade." This attitude makes me sad, since it implies that learning only starts at school and that learning is no fun. What we experience with the children is so different: they are hungry to get to know and understand their world, and they have such joy in learning. They feel so proud when they figure out something themselves and they come to the classes eagerly, since they sense the high respect we have for them and for their learning process. The children brought us such great rewards that we wanted to give up our careers and concentrate 100 percent on science education for young children.

During our initial research, we had looked into other science programs available for young children. We found a variety of smaller and very local initiatives, and international initiatives like Hands-On Science in the U.S. or La Main à la Pâte in France. However, none of those initiatives was suitable for broader implementation in Germany, since they either lacked the quality standards we wanted or they were clearly linked to a specific state education or cultural background. In spring 2003, we had successfully completed a number of Science-Lab courses for a small number of children. We knew that the way we were doing it was different from anything that had been done in Germany and other countries before, and we saw rising demand from parents in other areas in Germany who had heard about Science-Lab through friends or articles in German newspapers and journals (e.g., *Der Spiegel*). We realized that we had to make a decision on how to proceed.

EXPANDING REACH AND CONTENT

In April 2003, two things happened at the same time. First, parents of children attending our kindergarten courses asked us to develop courses for children of primary school age—that is, for the older siblings of our young students. We proceeded to expand our concept for an older age group and planned to start trial sessions in the summer. Second, we started to receive phone calls from parents in cities far away from our base near Munich who wanted Science-Lab courses for their children in their area. Since there was no chance for us to travel around teaching science, we had to find people teaching science in the way we thought most successful and meaningful for the kids. In order to find such people, we turned to the parents calling us and asked them if they wanted to become science teachers for their children, especially since most of them had a university degree, many of them in

engineering or science. That is how we recruited our first three Science-Lab teachers. Using the knowledge and skills of highly qualified parents proved to be a very successful idea. Only later we found out that other models use that resource as well; for instance, the Parents as Teachers program in the U.S.

After consulting with a lawyer and a tax consultant, we realized that German law would make it difficult and risky for us to employ people far away, so we decided to license the Science-Lab concept and make it a franchise; we learned only much later that we were probably the first social franchise in Germany. We wanted to reach people who committed themselves for a certain period of time, who had the fire burning inside them to do this kind of work with children, who were able to contribute to the training cost but whose priority was not to make money off this work. Since being selected as an Ashoka Fellow in 2006, I have shared our approach in multiple public discussions and with other German fellows, like Meinrad Armbruster (Eltern-AG), Rose Volz-Schmidt (wellcome), or Judy Korn (Violence Prevention Network), since they faced challenges similar to ours. By using a social franchise approach, we reached the most committed people who were able to work independently, while giving us the chance to ensure the quality and sustainability we consider most important for that kind of work. What started out with three people in spring 2003 has now become a group of more than 60 highly dedicated and committed science teachers for kindergarten and primary school children. All the teachers have a strong relationship with us, which goes far beyond the realm of contracts. We have a process in place that helps us find and retain these important agents for our children. If someone is interested in becoming a teacher with us, we usually talk to them on the phone to explain what we are doing and how we are doing it. To get a personal impression, we encourage the candidate to visit a session with one of our teachers close to where the candidate lives. If the candidate and the teacher both have a positive impression, we engage in more specific talks and, if successful, greet her or him as a new member of our Science-Lab community.

The candidate chooses the first science course she or he will train for and meets with other teachers at one of the training weekends. We have no more than four training weekends per year in order to get as many people together as possible. Because we are all working on a local basis, we need to provide opportunities to exchange experiences and ideas and for personal contact. Therefore we teach several of our courses on one weekend. Those weekend trainings are extremely intense and at the same time stimulating, motivating, and fun. We always have a mixed group of beginning teachers and teachers who are attending in order to expand their repertoire to include other age groups or topics. One of our teaching techniques is to use role-play to emulate real-life situations with the children. Each teacher has to present a trial session that simulates parts of a lesson with the children, which is treated like an exam. Every participant receives feedback and coaching from the trainer and from the other participants, and they leave the session with clear knowledge about their strengths and challenges. Even after the training, nobody is left alone. Regular contact with the teachers identifies challenges and

Figure 1. Map of Germany, Indicating Locations of Science-Lab Teachers.

opportunities and gives them the chance to get better every day. In the beginning, Sonja and I were coaching all of our teachers ourselves. As the organization grew, we identified teachers with the necessary skills to take care of the teachers in their local region. We currently have leaders in six German regions: in Berlin, and in northern, western, central, eastern, and southern Germany. We also have one person responsible for Austria, one for Switzerland, and one for non-German-speaking countries, with Spain being our main focus at present. The number of Science-Lab teachers has grown steadily since we started to license our program, especially in highly populated areas such as Berlin, Frankfurt, and the Rhein-Main area, Munich, and the Ruhr valley. We are currently working on reaching other areas in Germany while maintaining our high quality standards.

We have established a variety of important tools that help us monitor the quality of and support for our teachers. Every teacher has to give feedback about each session taught. The regional leaders look at this feedback and take action if necessary. For example, if a teacher reports having difficulty taking the children's questions in a particular session and developing a meaningful learning experience out of it, the regional leader calls the teacher to discuss how we can assist them. Sometimes we have to strengthen content skills, sometimes a different methodological focus is needed, and sometimes a teacher needs help in understanding the children better. By supporting Science-Lab teachers in their daily work, all of them grow in experience and the quality of our work improves constantly.

The feedback is also used to update every course we have developed once a year. That gives us the chance to incorporate comments, ideas, new experiments, and educational games that our teachers and their children have developed into the Science-Lab curriculum and make them available to all of our teachers. Every teacher receives a yearly update so that she or he can implement all the other teachers' ideas and improvements. The next pillar of our quality system is parents' and children's feedback. After a teacher runs a course, parents and children are asked for their feedback on a short questionnaire, which gives us important information about how to make our courses and activities better. The third pillar of our quality system is that we see every teacher personally at least once a year. If they don't attend a training weekend, they are required to participate in one of the seminars we offer about twice a year. This allows us to ensure that all Science-Lab teachers maintain the highest standards in teaching science to young children.

Over the last seven years, we have reached about 17,000 children through these extracurricular science courses. This seems to be an impressive figure, looking at it as a program started from scratch. But do we reach all kids? By no means. We are not even able to fulfill the current demand, as we don't have enough Science-Lab teachers to cover all of Germany, as the map shows. Parents will not drive a child longer than 30 minutes to attend a 45- to 90-minute class. Therefore, in order to reach children where they are educated, we need to train kindergarten and primary school teachers how to teach science to young children in a fun yet sustainable way. In doing so, we can give our children a foundation of basic science knowledge through kindergartens and primary schools. Ideally, children who discover their interest in science through their school or kindergarten would be offered extracurricular courses. Science-Lab teachers giving these courses could identify young science talents and give them the chance to pursue their interest even further, together with other children that were selected because of their special interest in natural science. Basically, this early vision is what we have been working on for the last five years, and still are.

REACHING OUT TO ALL CHILDREN

By the end of 2004, we had proven that our concept of science teaching for young children worked. We also proved that it wasn't solely dependent on Sonja and me and could be transferred to other people and regions. Newspaper and journal articles about Science-Lab helped us become known to a wider group of interested people. It also helped us tackle the next step and gain access to professionals in kindergartens and primary schools. In order to establish science teaching in other areas, we needed to include science in the curriculum and at the same time qualify the teachers to implement the science content in the classroom. As a result of discussions held in the aftermath of the PISA studies, the 16 German states one by one integrated science into their kindergarten and primary school curricula. Even though Science-Lab was very young back in 2004, the Bavarian Institute for Early Childhood Pedagogy asked us to contribute the science section of the Bavarian

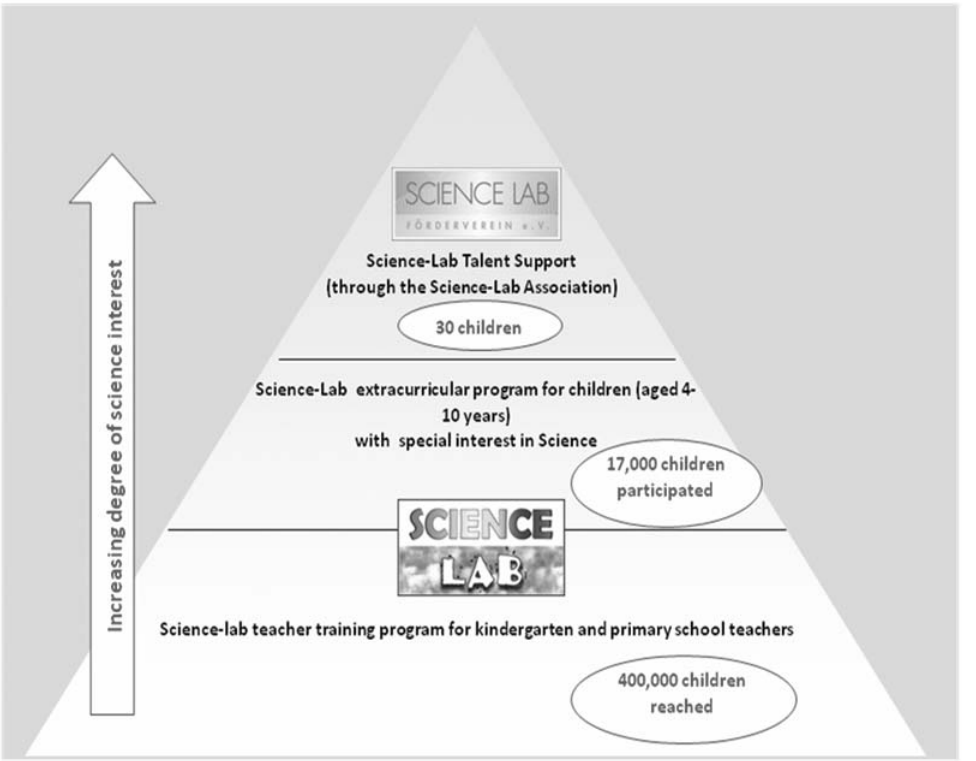

Figure 2. For a holistic approach, we envisioned a pyramid-like structure to science teaching for young children in Germany.

kindergarten curriculum. Today, all German states have a written science curriculum for both kindergarten and primary schools. I mention both institutions because they are quite different in Germany. While primary schools are administered by state education ministries, kindergartens are usually administered by the state ministries of family, health, and seniors. This means that the transition from kindergarten to primary school often isn't as smooth as it should be. Furthermore, merely putting a science curriculum in place is not sufficient; if we want to implement this curriculum in the classroom, we need to support the teachers in doing so.

BACK TO THE ROOTS: THE TEACHER PERCEPTION PROBLEM

As I mentioned earlier, many German teachers at the kindergarten and primary school level seemed reluctant to engage in science topics. This is likely due to their own (perceived or real) lack of scientific knowledge due to their experience with natural science at school. Many kindergarten teachers told us that they chose their career in part because they didn't like science at school and didn't want to be involved in natural science. Many of those teachers experienced science as a for-

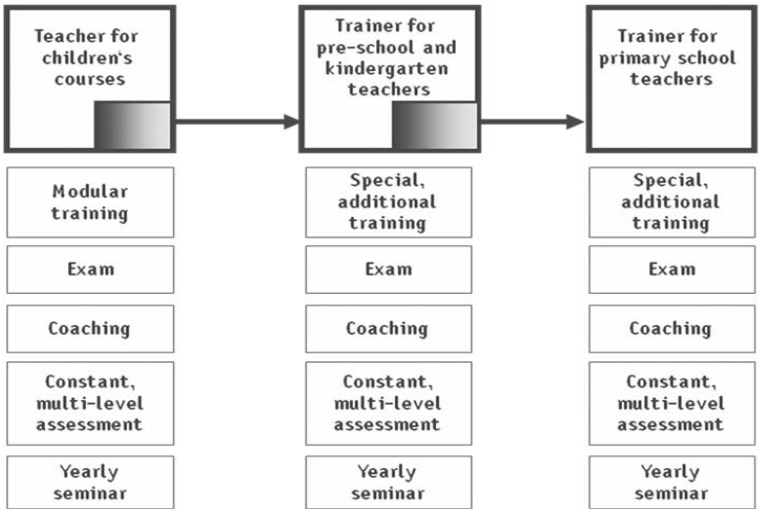

Figure 3. Quality system for Science-Lab teachers.

mula-driven applied mathematics course and had hardly any understanding of the phenomena that were the basis for the mathematical interpretation. When we asked them about their science experience and associations, we got far more negative than positive comments. Therefore, one of our main goals was to change the teachers' perception of natural science into something exciting, fun, and worth exploring. Moreover, rather than pushing our experiences and knowledge into kindergartens and primary schools, we wanted teachers to ask us for support. We also knew that the amount of time and commitment we expected from our Science-Lab teachers was far too much to expect from teachers in kindergartens and schools, as they had other engagements and targets to meet. Therefore, we developed a specific teacher training, first for kindergarten teachers and later for primary school teachers. We focused on phenomena that were as close as possible to the work of kindergarten teachers that they used almost every day, such as colors. Another example is sound, since music plays such a vital role in every kindergarten child's life. Although teachers and children make a lot of music in kindergartens, they didn't look at it from a scientific point of view. Starting with just a few phenomena, we helped them little by little to put on their "science glasses" and look at (feel, hear, and smell) their world with a young scientist's eye (hand, ear, and nose). We worked with kindergarten teachers in our vicinity and were able to monitor their implementation of our activities on a day-to-day basis. This helped us refine our offerings and convince other kindergartens to send their staff to our training sessions.

At first there were only a few, but we treated every teacher as a valuable resource and someone who could influence the life of children significantly. We

were happy about every child who was inspired by his or her teacher to explore science even further. Amazingly, we were able to turn around teachers' attitude toward science with only one day of training. Kindergarten teachers in particular were enthusiastic and thankful after the training. One said, "Had I learned science that way, my life would have unfolded quite differently." One age 50+ teacher commented, "That was the very first time I thoroughly enjoyed a training day." We have now trained close to 8,000 kindergarten teachers in our one-day basic session, and almost all of them left our training convinced that science isn't as difficult as they always thought it to be. Furthermore, they find fun in exploring science phenomena through the eyes of the children and are keen to try their new knowledge and skills with their students. Many of the teachers come back after 12 or 18 months to reflect on their work and explore new topics. Many of them also use our training as a starting point for exploring the world of science phenomena with their children, even in areas previously unknown to them. Those results are the most rewarding for us, since we reach the children and their teachers, and are able to change their attitude toward science and their understanding of it.

We maintain contact with the teachers attending our trainings to make sure they have what they need to put on the "science glasses" in their daily work. It is also essential for our quality assurance. All participants are asked for feedback immediately after the training and are sent a questionnaire approximately 18 months later to find out how well the implementation of science content went in their kindergarten classes.

The Science-Lab teachers who train other professionals have to qualify for the job by having extensive experience working with children of the relevant age group. They also have to be able to work with adults. We train them specifically for that kind of work, again followed by an exam and a coaching process while they first attend teacher-training sessions and gradually lead one themselves. They are monitored and required to give feedback after each teacher training, and they meet with all other teacher trainers ones a year to discuss new developments, challenges, and ideas.

Basically everything I described for kindergarten teacher training is true for the training of primary school teachers. However, primary school teachers are much more restricted by their state curricula. Primary schools in Germany have educational targets to meet or certain areas to cover in their teaching, including science. Even though Germany is a small country, it has 16 states. All schools are under the control of the state governments rather than the central German government, which leads to 13 different primary school curricula (some northern German states have a joint curriculum). When we looked at those primary school curricula, we found that all demand teaching of more or less the same science phenomena. Therefore, we developed our primary school teacher program with a focus on the phenomena rather than the 13 different curricular demands. However, when we teach teachers in a particular German state, we have to consider where the teachers come from and specify our training to the curriculum they know in order to offer them optimal support. Apart from that, the situation in a

primary school classroom in Germany is considerably different from the kindergarten classroom. In German kindergarten, one class has no more than 25 children, with one teacher and one assistant present at all times. In primary schools, a teacher quite often works with 28-30 children without an assistant, and in many schools classrooms are crowded. Traditionally, parents rarely come to the school for help during the day. This meant that we had to build organizational measures and ideas into our training to cater to this situation. Just as with the kindergarten teachers, a minority of primary school teachers had the solid science background knowledge that gave them confidence to try out new, modern, or different teaching approaches in the field. That's why our training has to deliver both content knowledge and understanding, as well as science teaching methodology.

THE RECIPE FOR SUCCESS

What are the reasons that children, parents, and teachers alike are inspired by our approach to science teaching? There are eight main factors we see as crucial to this process:

- We look at the world through children's eyes. We take their interest seriously and connect with them.
- We look at a phenomenon and come up with questions about it. It doesn't matter if the phenomenon belongs to the field of biology, chemistry, or physics. The phenomenon itself is the focal point and we try to understand as much of it as children in that particular age are able to.
- We explore and accept various venues to find answers to our questions. Often there is more than one venue and even more than one answer.
- We treat every comment and idea with respect and create positive learning experiences.
- We use a scientific approach to investigate a phenomenon or topic—from question to hypothesis to proof and communication.
- We come back to a topic several times and look at a phenomenon from a different angle or at another level. In pedagogy, that is called a spiral-type curriculum.
- We give children time to explore and investigate at their own pace.
- We talk about the process, findings, and results with the children. That way we simultaneously enhance their communication skills.

These are the factors that make all of our programs so meaningful for participants, be it the extracurricular courses or the teacher trainings. The success of Science-Lab as an enterprise is due to a great extent to the high standard. But it is also true that starting this venture with my friend and partner Sonja was crucial for its ongoing success. Sharing the same understanding and values gives us the chance to stand in for each other whenever needed. However, we find it easier to be in there together, especially in times of crisis, and to help each other master challenges.

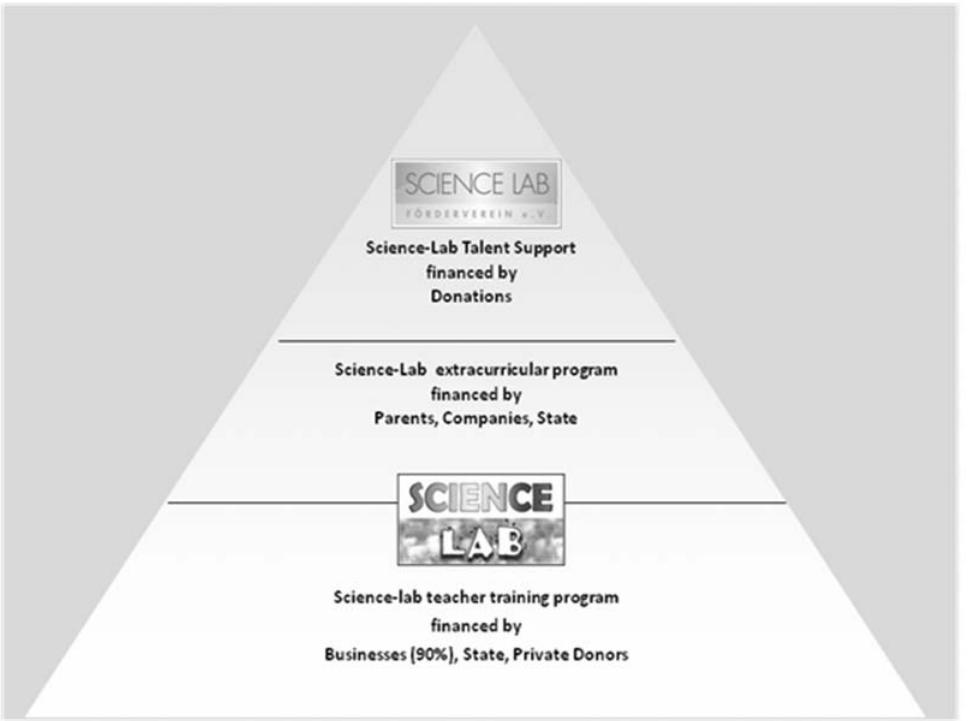

Figure 4. Starting at the top, the talent support is 100 percent financed through private donors.

OVERCOMING OBSTACLES

Naturally we had and always have obstacles to overcome in building up a venture like Science-Lab. There are basically three major challenges we have faced or are still facing. One comes from some professionals in the field of education. Educating the young is a task that a society has to fulfill. In Germany, however, the explosive number of private schools being founded recently (Oelkers, 2007) and the PISA results show that parents are not completely satisfied with the way this task is being carried out, particular as Germany's test results fall behind those of other countries. The fact that education issues are the responsibility of 16 different state education ministries causes many institutions to work on the same tasks in each state. This requires more financial and personnel resources than would a national education policy and fewer institutions. By dispersing these resources, less money and manpower is available to transfer good ideas and research results into practice. Furthermore, entrepreneurial solutions like ours are often looked at suspiciously by people working in the state system because it didn't come out of that system. For example, state decision-makers sometimes reject our approach because they didn't invent it, even if we partner with someone who would fully

finance the project within a school district. The only way we can overcome such prejudice is to work with people in the state education system who are more open to new approaches and prove to them, through our high-quality work with teachers, that their decision to trust us was right. In our experience, the pull comes from teachers who know our work, thus we are changing the system from the bottom up.

Our second major challenge is the constant fight to get our work paid for in order to keep Science-Lab up and running. Coming back to the pyramid I described earlier, we have three ways to finance our work. The middle part of extracurricular courses is financed by the parents who send their children to our afterschool program. In some cases, companies pay for courses for their employees' children, or schools spend some of the money the state allocates to them for afterschool activities for a Science-Lab course. We would like to achieve a financing model in which a child's participation in an extracurricular Science-Lab course depends on the child's interest and not on the parents' financial situation.

The greatest financial resources are needed for the teacher-training program. This is a real struggle for us, as we lack access to influential decision-makers in the 16 German states and the federal government. Developing our venture in an entrepreneurial way, we turned to businesspeople for help. We especially approached companies that produce technology-driven products and that are searching the job market for well-trained graduates in the fields of engineering and science. Those graduates are hard to find in Germany these days (Reinberg & Hummel, 2003). We were able to convince some of the managers to take a rather long-term perspective and donate some of their revenues to the educational development of kindergartens and primary schools within their vicinity. By now, about 90 percent of our teacher trainings are financed by companies or their spin-off foundations. It may sometimes be tedious, but this grassroots approach, in conjunction with our exceeding expectations, has brought us the respect and the pull of people working with us. Eventually we will have a strong enough anchor within the educational practice so that the state system cannot ignore us.

The third challenge is the most severe and it has to do with copying our work. Any successful concept will be copied; there is no doubt about it. A successful concept should be copied in order to improve or overhaul the system. However, the copying that has occurred so far in Germany has not met the appropriate standards and thus undermines both the reputation of the original and the wider goal. We already addressed the reluctance and fear professionals have with regard to the natural sciences. If teachers attend trainings that reinforce all the stereotypes of science teaching, they will turn their backs on science and feel confirmed in their sense that they never understood anything in that field, that they don't understand it now, and that they will never understand it. At that point a person is lost. The problem is that we most often have only one chance to reach these teachers. If a person has a bad training experience, they won't likely give it another try. However, if someone can adopt our approach successfully without plagiarizing it, we are more than happy to join forces with them in the quest to change science education

in Germany—and wherever it is needed. To accomplish this we are working to describe our standards and benchmarks clearly and to form strategic alliances.

MAKING IT PART OF POLICY

Our main goal is to implement high-quality science teaching in all preschools, kindergartens, and primary schools in Germany in order to give children a sound science foundation before they enter higher schooling. Discussions over the last few years have led to changes in the written curricula for kindergartens and schools. To transform the written curricula into action is the greater challenge right now. Science-Lab aims to set the quality standards and benchmarks for that implementation process.

FUTURE VENUES

The last seven years were extraordinarily eventful and busy. Science-Lab is currently in a consolidation phase, working to ensure that the method and the quality of science teaching for young children become established throughout the German education system. We are regularly developing new formats as demand arises, such as joint workshops for parents and children or teacher trainings for special needs teachers. We also started to go international and trained teachers from German schools in Italy and Spain, as well as teachers from international schools in Germany. The lack of implementation of science teaching in the way we do it is not a problem unique to Germany. As we have learned at international conferences, other countries encounter the same difficulties. Therefore, we believe that we can contribute to the process of establishing science curricula for kindergartners and preschoolers on an international level as well.

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