



**World Links for Development: Accomplishments and Challenges
Monitoring and Evaluation Annual Report
1999-2000**

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World Links for Development: Accomplishments and Challenges Monitoring and Evaluation Report Year 2: 1999-2000

Executive Summary

In the context of a rapidly changing economic environment, the World Bank Institute (WBI) launched the World Links for Development (WorLD) program in 1997 to expand access to digital learning resources and address the growing disparity between the technology haves and have-nots. WorLD connects secondary school students and teachers around the world to engage in collaborative learning using information and communication technologies (ICT). The Program also seeks to enhance cultural understanding across nations and help youth develop skills that they will need for obtaining jobs in the 21st century.

The WorLD program is currently active in 15 countries in Africa, Latin America, and the Middle East, and provides training for teachers in five languages: English, Spanish, French, Portuguese, and Turkish. Since 1999, African and Middle Eastern countries participating in the WorLD program have been supported through the newly established World Links for Development (WorLD) Organization, a nonprofit organization. Latin American countries' participation in WorLD has been supported through financing from the World Bank Institute.

This Monitoring and Evaluation report assesses the WorLD program in its second full year of operation, July 1999 - June 2000. The Center for Technology in Learning at SRI International in Menlo Park, California, was contracted by the WorLD Organization to conduct the evaluation. The goals of this report are to:

- Describe the implementation of the WorLD program and barriers to implementation throughout participating countries.
- Examine the differences between WorLD and non-WorLD schools in terms of teachers' pedagogical practices, their uses of computers, and their assessment of the impact of computers on learning outcomes.
- Determine the effect of the Program and other contextual factors on teachers' pedagogical practices, uses of computers, and assessment of the impact of computers on student outcomes.
- Identify existing challenges and offer recommendations for Program improvement.

To address these objectives, SRI, working in collaboration with WorLD program staff in each country and the World Bank Institute Evaluation Unit, surveyed a sample of teachers in WorLD and non-WorLD schools in 12 of the 15 currently participating countries: Brazil, Chile, Colombia, Ghana, Mauritania, Mozambique, Paraguay, Peru, Senegal, South Africa, Uganda, and Zimbabwe. Data were collected from more than 500 teachers in 140 schools regarding pedagogical activities, use of computers to support these activities, implementation of the WorLD program, impediments to implementation, and assessment of the impact of computer use on student learning. The findings of this report are based solely on an analysis of the teacher survey responses.

Implementation

Although the WorLD program has supported school improvement in participating countries by equipping schools with computer hardware and software, the provision of professional development to enhance teachers' technological and pedagogical skills has been its most important contribution. In Year 2 of the Program, teachers reported having received training from a wide variety of providers, including WorLD program headquarters staff, WorLD country staff, the WorLD coordinator at their school, and their fellow teachers. Teacher responses to survey items also indicate that many teachers received training in a number of areas, including the use of Internet software and application software, how to design and lead collaborative projects, how to use student groups in teaching, and how to collaborate with other teachers to develop instructional materials.

In its second year of operation, the WorLD program has helped to cultivate pockets of innovation in schools using ICT to improve education. Implementation has picked up momentum, and many countries are expanding the Program to different schools. Data reveal that all participating WorLD schools are integrating ICT into the classroom environment in a variety of ways, and this integration has resulted in noticeable changes in students' practices and teachers' pedagogical strategies. Teacher survey data also show that there are significant differences between WorLD and non-WorLD classrooms. Teachers who participated in WorLD were much more likely than computer-using teachers in non-WorLD classrooms to collaborate with other teachers and to design collaborative projects and activities for their students. WorLD students, according to their teachers, used ICT with greater frequency than their non-

WorLD counterparts to perform a wide variety of information-gathering and communication tasks. WorLD students and teachers were also more likely to collaborate on projects with others in their own country and in other countries.

Outcomes

The Program has gone a long way toward improving student learning, according to the responses of participating teachers. A large majority of the teachers felt that working on computers in the WorLD program had an impact on a range of student skills, knowledge, and attitudes. Seventy-eight percent of WorLD teachers surveyed indicated that student knowledge about the use of computers had increased "a lot" or "a great deal" as a result of working with computers. Teachers also had positive assessments about the impact of computers on increasing students' general knowledge and communication skills. A major strength of the WorLD program has been the promotion of equitable gender access to and use of computers in participating schools. Survey findings reveal that girls and boys are acquiring and developing information literacy skills at similar levels.

A large majority of teachers agreed that their participation in the WorLD program had resulted in the acquisition of new skills and attitudes in both technology and pedagogy. Teachers reported that the Program had the greatest impact on their skills to design and prepare projects for students, learn more about their subject matter, and have students work in groups. Sixty-eight percent of WorLD teachers stated that computers helped them to design or prepare collaborative student projects "a lot" or "a great deal." More than 70% of the teachers felt that the Program had greatly improved their ability to use computers and the Internet, and more than 80% of WorLD

teachers indicated that it had improved their attitudes about both technology and their own teaching. In addition, approximately half of all WorLD teachers felt that the Program had increased the amount of collaboration among teachers in their school on the design of projects for their students.

Barriers and Recommendations

The overall findings of this report suggest that the health of the WorLD program is strong. During its second year, the Program has been growing and evolving, adapting to a number of educational environments unique to each country. However, despite the significant progress that WorLD has made, particular barriers persist. For example, in the nations of both Latin America and Africa, teachers reported that the lack of computers, inadequate hardware/software, unreliable Internet access, and the scarcity of time constituted the major barriers keeping them from using computers in their teaching. A smaller number of teachers in selected countries also indicated a need for more technical support in integrating ICT into the curriculum and stronger national policies on the role of technology in student learning.

To address these barriers preventing teachers from using computers in instruction, SRI recommends that the Program and the national ministries of education:

1. Engage in strategic planning, create new funding schemes, and consider the use of new technologies (e.g., wireless solutions) in their efforts to improve technology access, reliability, and flexibility.
2. Develop strong national policies outlining the role of ICT and establish mechanisms that strengthen the role of teachers to better use technology in innovative ways. Additionally, curriculum, assessment, and training practices should be better aligned with the role of ICT and each country's national education goals.
3. Provide teachers with more professional education on technology integration on an ongoing basis through follow-up coaching, a teacher on-line network, peer coaching, and schoolwide professional development. Additionally, teacher training should focus on interdisciplinary technology projects and practical strategies for technology lesson implementation.
4. Create additional organizational structures and support for teachers to facilitate teacher learning and implementation of ICT in education.

World Links for Development: Accomplishments and Challenges Monitoring and Evaluation Report Year 2: 1999-2000

Introduction

Over the last 20 years, computers and information technologies have dramatically changed modern life. Developments in information and communication technologies (ICT) have rapidly expanded all around the world. This expansion has resulted in a virtual revolution that has intertwined economies, brought individuals from different countries and cultures together, and created increasing levels of economic prosperity. According to a report prepared by McConnell International (2000), electronic commerce has reached a critical threshold where action or inaction by national governments and industry leaders will either catapult developing countries into the knowledge economy or leave them behind in the attempt. The report states that “without significant progress over the next three years, these countries will face great challenges in catching up with the global leaders...” (p. 1).

It is in this context of a rapidly changing economic environment that the World Bank Institute (WBI) launched the World Links for Development, or WorLD, program in 1997 to expand opportunities and address the growing disparity among technology haves and have-nots. WorLD links secondary school students and teachers around the world to engage in collaborative learning using ICT, enhance cultural understanding across nations, and help develop skills that youths need for obtaining jobs in the 21st century.

In 1999, the World Links for Development (WorLD) Organization was established as a nonprofit organization separate from the World Bank Institute. This organization provides a flexible network supporting participating countries in their efforts to create an environment where ICT can be harnessed to improve education and employment opportunities, both inside and outside of schools. Since 1999, the WorLD Organization has supported the participation of eight African countries, and Latin American countries’ participation has been supported through financing from the World Bank Institute.

The five major components of the WorLD program are:

- The provision of Internet connectivity for secondary schools in developing countries.
- The delivery of extensive training in the use of technology to improve teaching and learning.
- Leveraging school-to-school partnerships, as well as regional and global partnerships with public, private, and nongovernmental organizations.
- Advocacy to lower telecommunication and connectivity costs for schools.
- A Monitoring and Evaluation component to assess impact and inform Program improvement.



School children at a WorLD Conference in South Africa

The WorLD program is currently active in 15 countries in Africa, Latin America, and the Middle East, providing training for teachers in five languages: English, Spanish, French, Portuguese, and Turkish. More than 500 schools in these countries are participating in the Program, reaching an estimated 100,000 teachers and students.

Evaluation Design

This document is the Monitoring and Evaluation report for the July 1999-June 2000 operational year of the WorLD program, its second full year of operation. The operational year includes the 1999 school year in the Southern Hemisphere and the 1999-2000 school year in the Northern Hemisphere. The Center for Technology in Learning at SRI International in Menlo Park, California, was contracted by the WorLD Organization to conduct this evaluation.

WorLD in Brazil

Brazil is one of the four original WorLD countries in Latin America. For the initial phase of the project, 10 public schools were selected in Sao Paulo. The first WorLD training session took place at the University of Sao Paulo in February 1998, with 40 participants. The project leaders report having trained 260 teachers from 21 schools during the last academic year. Topics for training included how to use the Internet, learning through collaboration, software applications, and other pedagogical and technical support. Country project leaders conducted follow-up visits and training once a month to work in the classroom with teachers. In addition, more than 1,000 students were involved in 15 collaborative projects during 1999-2000.

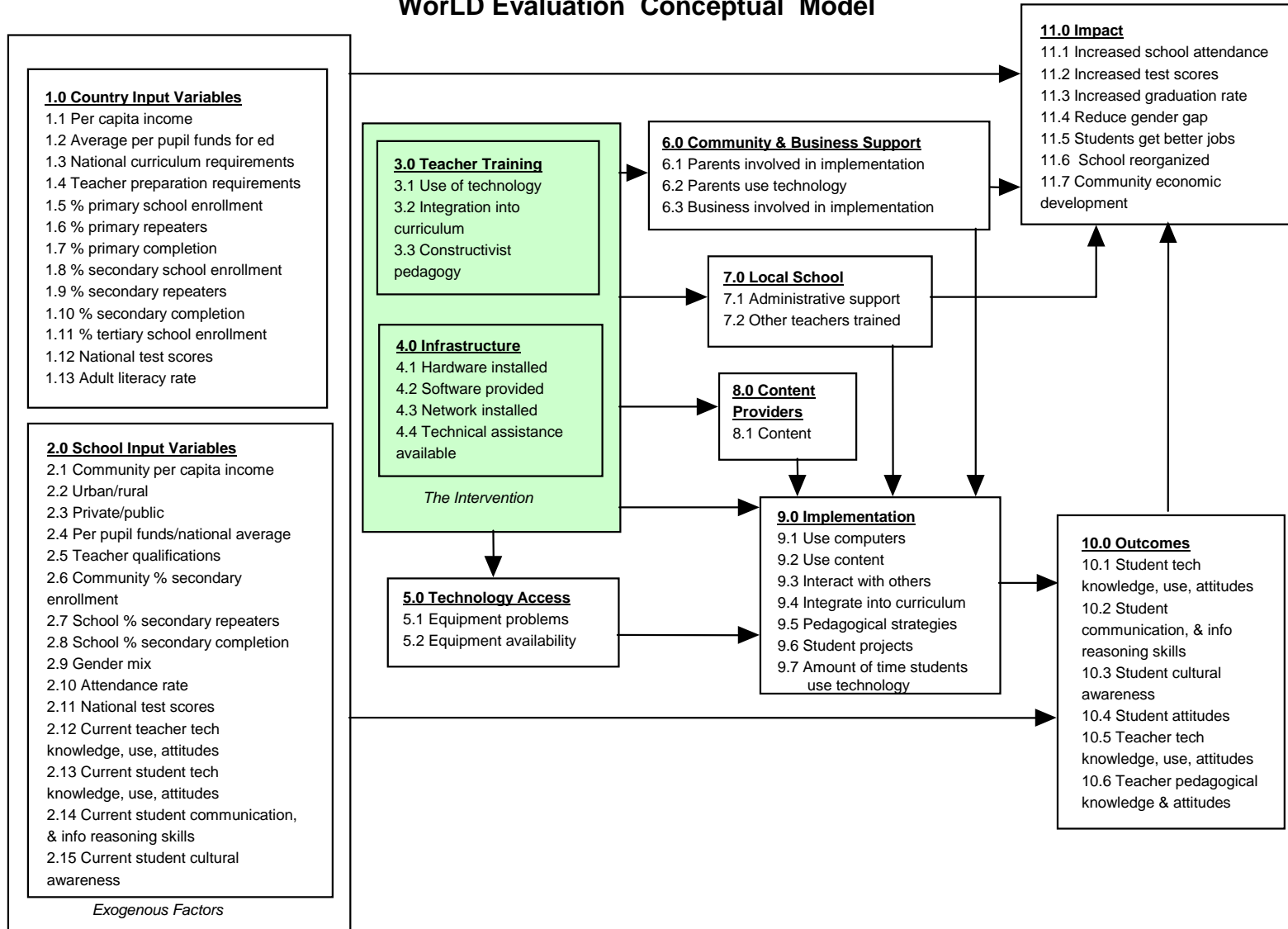
The evaluation was conducted in 12 of the 15 currently participating countries: Brazil, Chile, Colombia, Ghana, Mauritania, Mozambique, Paraguay, Peru, Senegal, South Africa, Uganda, and Zimbabwe.¹ The evaluation may expand to other countries as the WorLD program grows.

The conceptual model of the WorLD program evaluation in Exhibit 1 (on the following page) provides a convenient illustration of the types of variables examined and their hypothesized relationships. The model displays the independent variables related to the WorLD program intervention, which consists of two things: technological infrastructure and teacher training support. The effects of the intervention are likely to be mediated by a number of contextual and implementation variables that would vary by country and by school. The input or exogenous variables can be expected to influence the outcome and the impact variables, apart from a specific intervention. The outcomes variables are the results likely to be affected by the WorLD program intervention. These are variables that we think will be directly affected as a result of teacher and student interaction with ICT over the course of a school year. Impact variables are the long term results of WorLD as the effects of the Program cumulate.

¹This evaluation does not include the following WorLD countries: West Bank/Gaza, Turkey, and Botswana. Botswana and West Bank/Gaza just began to implement their projects in 2000, and Turkey is conducting its own evaluation.

Exhibit 1

World Evaluation Conceptual Model



The goal of the Monitoring and Evaluation component during the first year of WorLD was to provide the World Bank and the educational ministries of participating developing countries with information on early outcomes, implementation, challenges, and recommendations for improving the Program. Although similar to the Year 1 evaluation, the second year of the evaluation focused on:

- The implementation and impact of the WorLD program and barriers to implementation throughout 12 participating countries.
- The differences between WorLD and non-WorLD schools in terms of teachers' pedagogical practices, computer usage, and assessment of the impact of computers on learning outcomes.
- The impact of the Program and other contextual factors affecting teachers' pedagogical practices, computer usage, and assessment of the impact of computers on student outcomes across countries, and for the Program as a whole.

To address these objectives, SRI surveyed teachers in a sample of WorLD and non-WorLD schools in the 12 countries identified for study. The written survey was modified somewhat from the previous year's survey, focusing more on the three broad areas outlined above. SRI, working with evaluation researchers at the World Bank Institute, coordinated the modification of the

survey with the WorLD program staff to assure that it met the goals for the Monitoring and Evaluation component. The modified form in English was tested with a small group of WorLD teachers to verify that it could be efficiently administered. The final version was then translated into Spanish, Portuguese, and French.

Teachers in a sample of both WorLD and non-WorLD schools were carefully selected for participation in the evaluation. Teachers in schools similar in urbanicity, socioeconomic level, national exam results, school financing, and student-computer ratios were selected to complete the written survey. Sampled teachers in WorLD schools were stratified by the type of training they had received to participate in WorLD. The sampling plan for each school was designed so that two teachers would have received direct training from WorLD, one would have received indirect WorLD training from a colleague, and one would have received no formal or informal training. This plan was adhered to consistently in each WorLD school, with the exception of a slight deviation between the indirect training and no training categories. The final training percentages show that 50% of teachers received direct training from WorLD, 37% received indirect training from colleagues, and 13% had no formal or informal training at all.

Our findings are grounded solely on the perceptions of WorLD program teachers, who are both the primary target of WorLD's training program and well-placed to help evaluate the impact of the Program on their students. The exclusive use of teacher data, however, constrains our analysis of the impact of computers on student outcomes across the 12 countries surveyed. Without different kinds of data (e.g., qualitative interviews, classroom observations) from multiple sources (e.g., students,

WorLD in Uganda

Uganda was the first country in Africa to implement the WorLD Program. The effort began in 1996 with the School-to-School Initiative (STSI), a pilot program that focused primarily on helping students develop basic computer skills (word processing, spreadsheets, etc.) and secondarily on communication via the Internet. Integrating information technology into teaching content was not the objective of this program. Under the pilot, three senior secondary schools in Kampala (about 930 students affected) received the hardware and software necessary for training (1-2 hours a week) and establishing connections. In 1998, the program expanded to 10 schools and trained 55 teachers and administrators. Currently, WorLD is being implemented in 20 Ugandan schools, all with varying levels of connectivity and equipment.

administrators), there are few possibilities to corroborate teacher survey responses in order to enhance this evaluation's reliability.

Teacher surveys were administered from March to May 2000. Using the WorLD program infrastructure and country staff in each country, teacher questionnaires were distributed and administered in 96 WorLD schools. In addition to those who participated in the WorLD program, a number of non-WorLD teachers were surveyed to serve as a comparison group. In each country, we surveyed teachers working in schools where the WorLD program was operational but who had not chosen to participate in the Program. Additionally, the survey included four computer-using teachers from three to four schools in each country that did not participate in the Program. The survey return rate was 97%: 383 of 392 teachers completed surveys in the 98 WorLD schools, and 158 teachers out of 168 returned surveys in 42 non-WorLD schools.

The findings thus are based on the analysis of survey data from more than 500 teacher respondents in 140 schools in 12 countries. The first section of the report describes the implementation of WorLD, including the services it provides, how Program activities are changing classrooms, and what barriers are being encountered. The second major section of the report describes the outcomes of the WorLD program as it affected students and teachers. Subsequent sections of the report describe a country scoring system designed provide a comparative look at difference indices across different countries in the Program. The report concludes by offering a number of recommendations for Program improvement. The Appendix contains data tables that are referenced throughout the report.

Implementation

The WorLD program generally provides schools with networked computers and teacher training. According to findings from the Year 1 WorLD evaluation report (Kozma et al., 1999), WorLD's donations of computers to participating schools were leveraged by obtaining government resources to build computer laboratories. Additionally, grassroots efforts to raise funds from the community also helped many schools to cover their operational costs and sustain their participation in the WorLD program. However, teacher professional development is the most prominent aspect of the WorLD program. The following sections will describe the delivery of training to teachers, how technology is being implemented in their classrooms, and the major barriers that teachers confront in implementing instruction with ICT.



Teachers in Latin America discussing plans

What training services did the WorLD Program provide?

WorLD teacher training has been designed to roll out in four consecutive phases, thus allowing teachers and technology coordinators to understand each phase in the context of the entire WorLD program (WorLD Professional Development Phases, 2000). Each phase is coordinated to address the training needs of each country's teachers in an intensive manner over time. The four phases of WorLD professional development are:

- Phase I: Introduction to the Internet for Teaching and Learning
- Phase II: Introduction to Educational Telecollaborative Projects
- Phase III: Integrating Technology and Curricula
- Phase IV: Evaluating and Diffusing Innovative Classroom Practices

Each phase of training introduces a series of topics along with appropriate print and electronic materials for each activity. Some of the training—on computer basics, for example—is a prerequisite for Program participation. Training on pedagogical applications of computers is at the core of the Program offering. One of the recommendations offered in the Year 1 evaluation report (Kozma et al., 1999) encouraged the development of a WorLD training model that focused on the integration of computers into the curriculum. As a result, WorLD training has intensified

its focus on the integration of technology by infusing it into all phases of its professional development training. Using a “train-the-trainer” professional development model, the WorLD program hopes to give teachers greater autonomy and greater flexibility to share their knowledge and skills within their teaching community.

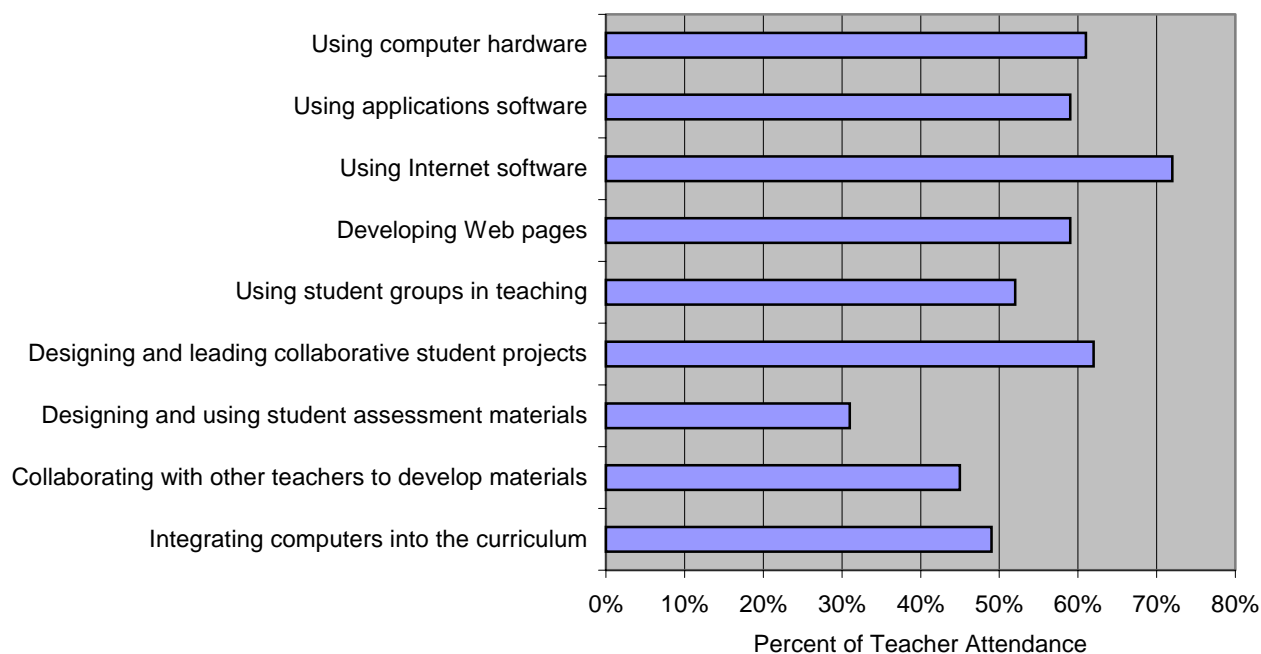
A number of different groups and individuals provide WorLD teacher training. In contrast to the first year, when a large majority of WorLD teachers (80%) reported receiving training from their WorLD country coordinator, teachers in the second year received training from WorLD program headquarters staff, WorLD country staff, the WorLD coordinator at their school, and their fellow teachers (see Table 1 in the Appendix). Informal training between teachers was less common. Only 25% of the WorLD teachers said that they informally trained other teachers in their school (see Figure 1 and Table 2).

WorLD Implementation in South Africa

South African began training for the WorLD Program in April 1998 with a pilot group of 45 teachers, students, and educators representing schools from every province. Now, four to five training workshops are conducted per year, and, to date, 528 teachers in more than 30 schools have received training. Approximately 1,800 students have participated in 17 collaborative projects. Schools actively involved in collaborative learning projects include Jan Celliers Laerskool and Micha-Kgasi High School, among others. The South African WorLD project has partnered with the Department of Education and SchoolNet South Africa.

As an interesting by-product of the project, 50 WorLD teachers participated in the National Education and Computing Conference in KwaZulu Natal in September 1998.

Figure 1
WorLD Training Topics Delivered



During the first year of the Program, most of the training topics focused on the use of technology (computer hardware and software). In the Program's second year, teacher survey responses indicate that teachers attended training workshops on a wide variety of topics (see Figure 1 and Table 2). For example, 72% of teachers said they received training on the use of Internet software, and 59% indicated that they received training on the development of Web pages. Teachers also said they received training on the use of computer hardware (61%) and applications software (59%). Workshops also emphasized project-based learning and student collaboration. Nearly 62% of the teachers said they received training on designing and leading collaborative student projects; 52% received training on using student groups in teaching; and 45% received training on collaborating

with teachers to develop instructional materials. As a result of their overall experience with the WorLD program, 90% of teachers expressed "a lot" or "a great deal" of satisfaction with the way the Program had been implemented so far.

In summary, the WorLD program has provided participating schools with computer hardware and software and, perhaps most importantly, with professional development to enhance teachers' technological and pedagogical skills. WorLD professional development training was provided mostly by WorLD and non-WorLD outside trainers and, to a lesser extent, by individual WorLD teachers who informally shared their knowledge and skills with their peers.

How is technology being implemented in WorLD classrooms?

A growing body of research literature documents a strong association between these new technology-based practices and changes in classroom practice (Means & Olson, 1997; Sandholtz, Ringstaff, & Dwyer, 1997; Voogt & Odenthal, 1997, 1999). For example, in many countries, the use of educational technology is part of a fundamental shift away from the transmission and rote memorization of facts to having students play a more active role in constructing their knowledge and understanding. Constructivist curricula and learning approaches emphasize group activities that encourage the development of collaborative skills and critical thinking and allow students to take more responsibility for their own learning (Collins, Brown, & Newman, 1989; Resnick, 1987; Totten, Sills, Digby, & Russ, 1991).

Instead of focusing solely on the acquisition of facts, teams of students are engaged in solving complex, authentic problems that cross disciplinary boundaries.

Constructivist curricula call for teachers—instead of merely lecturing—to design collaborative student projects, gather appropriate resources, and create the organizational structure and support that can help students succeed. ICT can support constructivist teaching methods by providing students with tools to augment the problem-solving process. Technology also can enable increased access to information and people around the world to support the development of a collaborative learning community (Means & Olson, 1997; Sandholtz, Ringstaff, & Dwyer, 1997; Kozma & Schank, 1998).

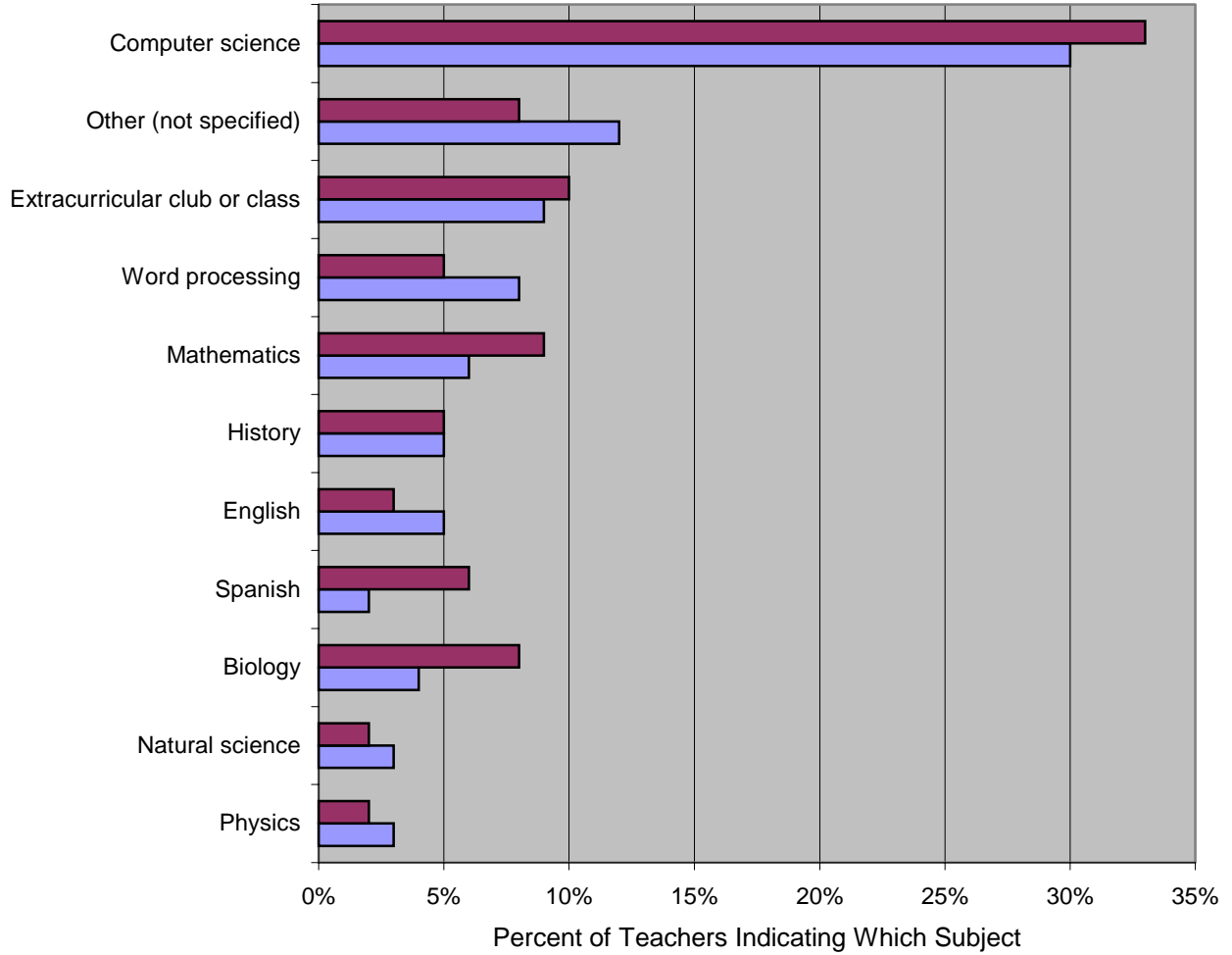
Some similarities exist between WorLD and non-WorLD schools in terms of classroom use of computers. For example, both WorLD and non-WorLD teachers reported that computer work is being done in similar subject areas. Most computer work in WorLD and non-WorLD schools is concentrated in computer science, mathematics, and word processing courses, as well as in extracurricular clubs (see Figure 2 and Table 3).

Student Collaborative Project in Paraguay

The Paraguayan WorLD Program has three collaborative projects that seek to address WorLD programmatic goals. One project, “Convivencia Pluricultural” (Living Together Across Cultural Boundaries), is designed so that students between the ages of 12 and 18 can learn how culture shapes a people and how people from different cultures learn to coexist with and accommodate other cultures sharing their territory. The project is deliberately interdisciplinary, drawing on social studies, communications, literature, music, and information technology. The project is also deliberately international, and students from schools in the participating WorLD countries are encouraged to collaborate with students in Paraguayan schools in designing research projects on the specifics of cross-cultural coexistence in their respective countries.

Using the Internet and other information technology, students in one country then share insights and findings with their participating peers in another country. Project activities include group projects, exchanges of data and files between different schools, the integration of research findings, and the preparation of a Web page with various groups’ research results and recommendations. The project is designed so that teachers and students use information technology to make long-distance presentations to their off-site peers.

Figure 2
Subjects in Which the Most Computer Work Is Done



■ Non-WorLD teachers (n = 67)
■ WorLD Teachers (n = 310)

However, survey data also revealed substantial differences between WorLD classrooms and non-WorLD classrooms. WorLD teachers and their students more frequently engaged in computer related activities in their classrooms than their non-WorLD counterparts (see Figure 3 and Table 4). Many of these activities were directly related to the use of computers; others reflected learning approaches that encourage independent and collaborative learning. Larger percentages of WorLD teachers indicated that their students used e-mail, search engines, bulletin boards/listservs, and the Internet an average of once a week or more. WorLD teachers also reported that their students were more likely to engage in a range of activities using computers more often than their non-WorLD peers. These activities include gathering data for a research project, collecting information about another country, exchanging information with students in another country, and collaborating with students within the same country or in another country.

In comparison with computer-using teachers in non-WorLD schools, WorLD teachers were much more likely to engage in collaborative learning projects with students and teachers in other countries. Forty-eight percent of WorLD teachers said that they had joined existing collaborative projects; only 11% of non-WorLD teachers reported having joined existing collaborative projects (See Table 5). Sixty-three percent of WorLD teachers reported that their students use computers to interact with students and teachers in other countries, compared with 9% of non-WorLD teachers.

In summary, there were significant differences between WorLD and non-WorLD classrooms. WorLD teachers were much more likely than non-WorLD computer-using teachers to collaborate with other teachers and much more likely to design collaborative projects and activities for their students. Additionally, WorLD students used ICT more frequently to perform complex, interactive tasks than their non-WorLD peers. Consequently, WorLD teachers were much more likely to have students collect and analyze data and use information to make predictions or draw conclusions. They also were more likely than non-WorLD computer-using teachers to have students collaborate on projects with other students in their own country and in other countries.

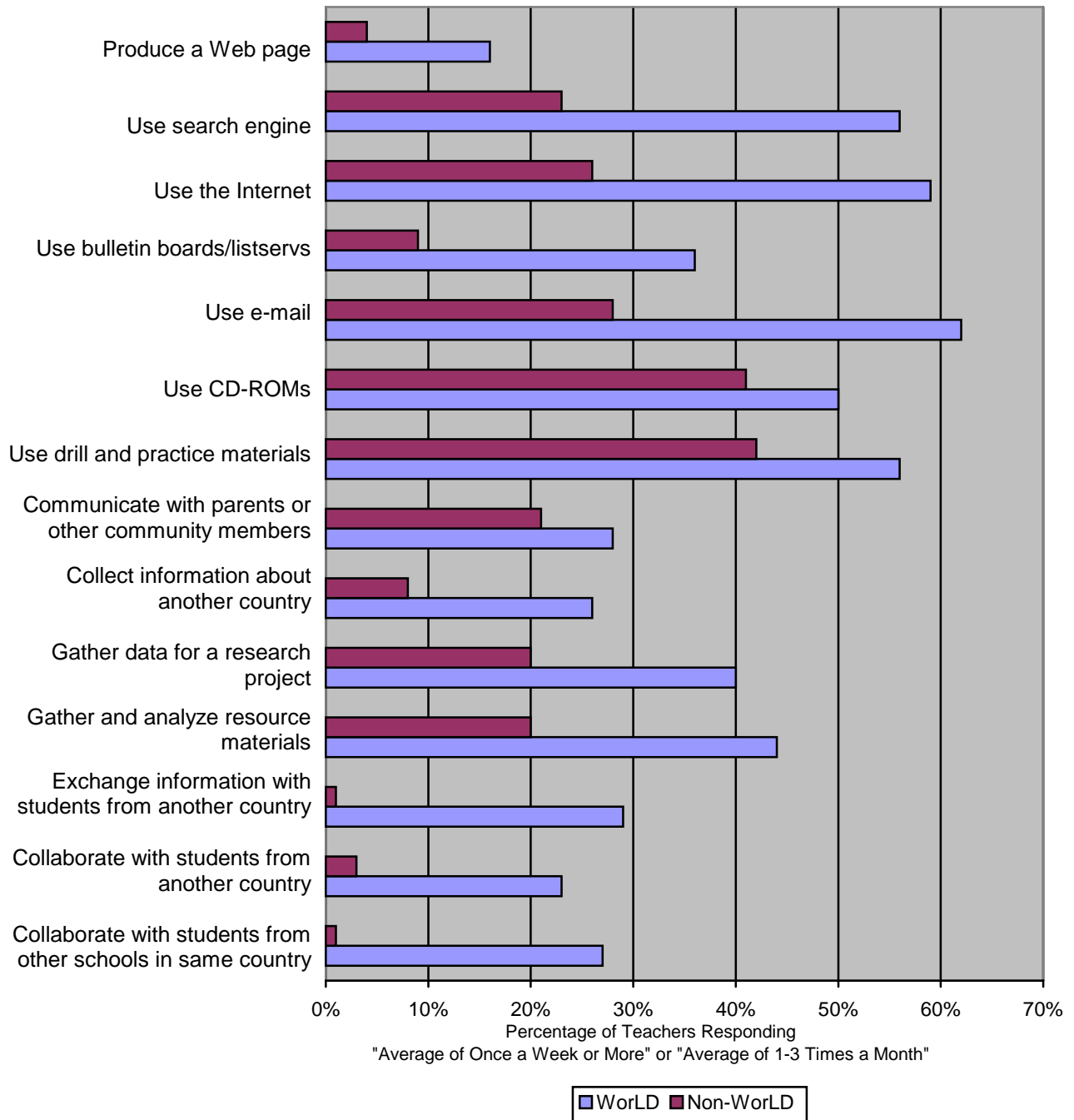
WorLD International Collaborative Projects

An international collaborative project, "Our Human Habitat and That of a Six Legged Friend," involved schools from Canada, South Africa, and Uganda.

The objective of this project was to engage the students in the collaborating schools in an exchange that would help them to appreciate and understand more clearly their own "living conditions" and community life, as well as to learn about how others live. The project also helped students to learn more about insects found in their own community.

At the end of the exercise, students were assessed on how well they were able to identify the components of their community, their environment, and the relationship between the two. To do this project, students had to exchange numerous e-mails describing or representing their home, their family, their neighborhood, and the physical environment. Students were provided with guidance on how to structure appropriate questions and discuss the different aspects of their family and community life.

Figure 3
Teacher Reports on How Often Students Use Computers



What were the barriers in implementing the Program?

The Year 1 evaluation report (Kozma et al., 1999) describes how innovations in technology-based programs often encounter problems at the start. In spite of the significant progress made by the Program in a short time, barriers continue to persist. Many of the barriers cited by teachers in the second year were similar to those encountered by WorLD teachers during the Program's first operational year. Thus, they continue to be challenges to be addressed in the short term as the Program plans for the long term.

WorLD in Zimbabwe

Zimbabwe's WorLD project is unique in using community telecenters with two full-time teachers staffing each one. Twelve telecenters exist: one in each provincial capital (Bindura, Chinoyi, Gwanda, Gweru, Harare, Marondera, Masvingo, Mutare), two in Bulawayo, one at Gutu, as well as one mobile WorLD van that provides ICT resources to remote rural locations and schools around the country. Each serves a cluster of 5 to 7 schools in an area. Of the 12 centers, 3 are located in schools. The project began in April 1999 with the training of 35 teachers in a Phase I workshop. Since then, more than 70 teachers have been trained in the 12 telecenters, and 400 students have participated in collaborative learning projects. Efforts are being made to establish 30 more telecenters for use by schools during the day and by communities and the private sector during the evenings and weekends.

In the second year of the Program, the major barriers cited by large percentages of WorLD teachers were the lack of computer hardware, software, and reliable Internet access (see Table 6). Similarly, approximately half of all WorLD teachers said that a major barrier was finding time in the school's daily schedule to implement computer-related activities in their classes. All percentages, however, varied from country to country. In general, lower

percentages (40% or less) of teachers reported that the lack of technical support or technology integration training constituted major barriers to implementing computer activities. Relatively few teachers among the 12 countries expressed a concern about the value of computers to their students, that technology would affect their job stability, computer activities did not match their instructional goals or methods, or that they did not receive support from their colleagues and school administration.

In Africa, WorLD teachers in most countries identified computer, infrastructure, and Internet access issues as major barriers (see Figure 4 and Table 7). Large numbers of WorLD teachers from Ghana, Mauritania, Senegal, and Zimbabwe reported that the lack of computers and software was a major barrier to implementing instruction with computers. With the exception of Mozambique, large percentages of African WorLD teachers identified the difficulty in finding time for computer activities given curriculum and testing requirements as a major impediment to implementing instruction with computers. In Senegal, half or more of teachers indicated that major barriers to implementing computer activities were the lack of technical support and training to integrate computers and engage in collaborative student projects. Teachers in both Uganda and Senegal noted that the lack of a national policy on the use of computers in school was a major barrier to using computers in instruction.

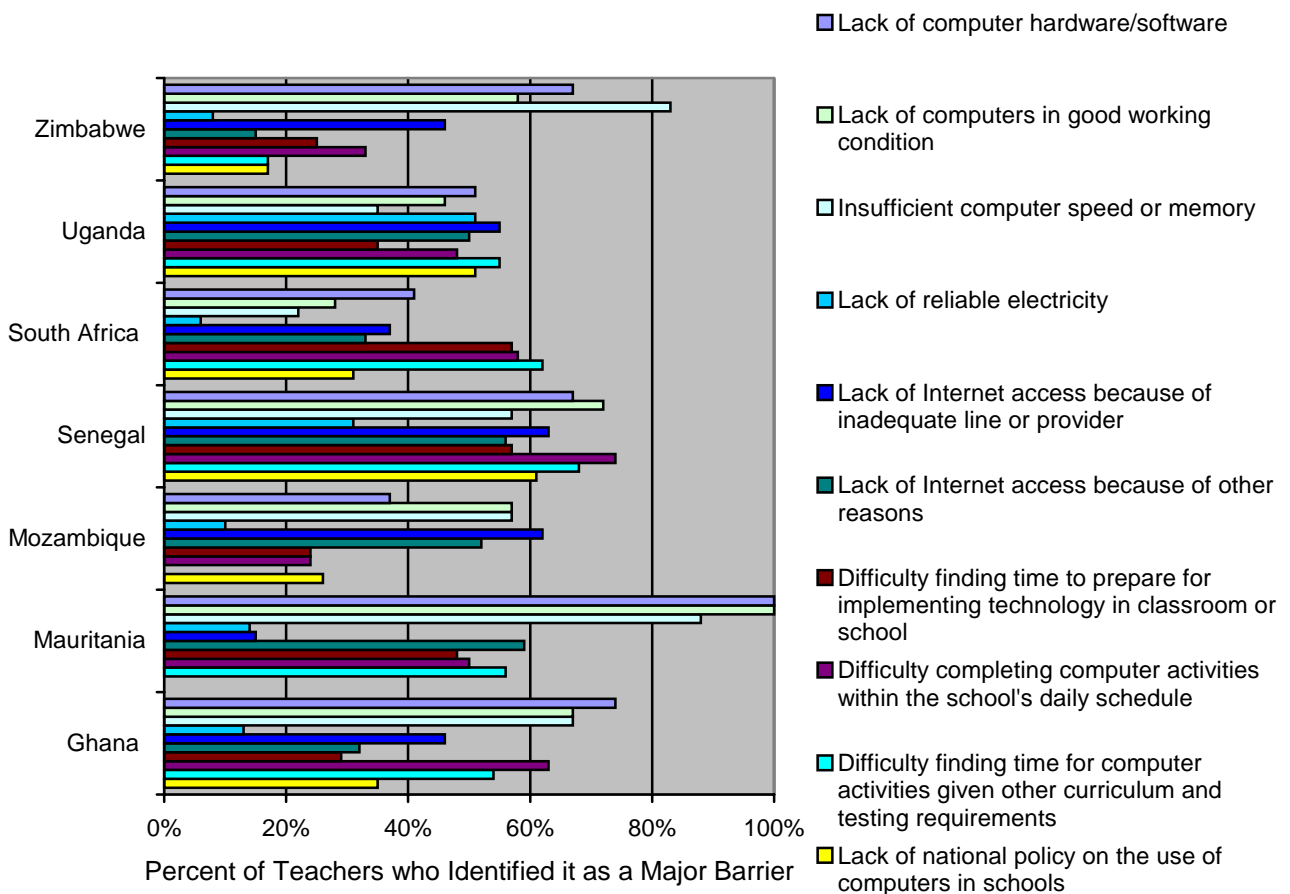
The lack of computers, hardware/software, and reliable Internet access constituted major barriers for teachers in all five countries surveyed in Latin America (see Table 8). WorLD teachers in Latin America also indicated that the scarcity of time was a major barrier to implementing computer

activities; however, the percentages in most Latin American countries were smaller than those in Africa. Large percentages of Brazilian teachers, in contrast to other Latin American teachers, identified a number of additional major barriers. WorLD teachers in Brazil felt that insufficient training or support for using computers, integrating technology, and using computers in collaborative student projects were major barriers. Brazilian teachers also said that lack of time was another major barrier. They also saw the need to meet existing curriculum and testing requirements as a

barrier to delivering instruction using ICT. Finally, 62% of Brazil's WorLD teachers indicated that the lack of a national policy on computer use in schools was a major barrier keeping them from using computers in class.

Teacher-identified barriers, along with other challenges, represent significant issues that need to be resolved in order to ensure effective Program improvement. These barriers will be addressed in the Summary and Recommendations section of this report.

Figure 4
Major Barriers Hindering the Use of ICT in African WorLD Countries



Outcomes

Computer technology is a powerful tool that is widely believed to have tremendous potential to transform education and improve student learning. Many educators and industry leaders believe that students must be able to use technology in order to live, grow, and work successfully in a rapidly changing and complex information-based society. According to the International Society for Technology in Education (2000), technology can help students become:

- Capable information technology users
- Information seekers, analyzers, and evaluators
- Problem solvers and decision-makers
- Creative and effective users of productivity tools
- Communicators, collaborators, publishers, and producers
- Informed, responsible, and contributing citizens.

The WorLD program emphasizes these important competencies and promotes international understanding and knowledge of other cultures, countries, and languages. In this evaluation, the acquisition of these skills and attitudes by students and teachers was measured indirectly through teacher responses. These outcomes will be discussed in the following sections.

WorLD in Senegal

According to the country coordinator, the program is having a positive impact on students in a number of areas. He reports that personal Web page development and the production of school newspapers are increasing in many of the WorLD schools, and that increasingly students want to develop ICT skills before obtaining their diploma. In spite of the fact that students are somewhat satisfied with the small amount of time they can spend using ICT, he reports that a new relationship between the teachers and students is developing as teachers accept the growing expertise of their students.



Students in Brazil working at their terminals

How did students benefit from the WorLD Program?

Overall, WorLD teachers offered positive impressions about the Program's impact on students' skills, attitudes, and knowledge. Sixty-nine percent of WorLD teachers said the Program had a large or great impact on improved technology skills, and 78% of teachers reported that the Program positively influenced their students' attitudes toward technology (see Table 9). Teachers also rated the Program highly on improving communication skills (70%), school attitudes (67%), students' reasoning skills (63%), multicultural knowledge (61%), improved ability to get a job (59%), and school attendance (64%). Smaller percentages of teachers indicated that the Program had a large or great impact on increased scores on national tests (45%) and increased passing rates to the next grade (44%).

In the Year 2 survey, teachers were asked to assess the impact of computer use on student skills and knowledge. Working with computers has gone a long way toward improving student learning, according to the responses of WorLD teachers. Large majorities of the teachers felt that working with computers in the WorLD program had a positive impact on a range of student skills, knowledge, and abilities. For example, 78% of WorLD teachers said that student knowledge about the use of computers had increased "a lot" or "a great

deal” through working with computers (see Figure 5 and Table 10). Teachers also reported that computer use had increased students’ knowledge “a lot” or “a great deal” in the following areas: using the Internet (67%), communicating with others (67%), collaborating with others (65%), using software (64%), knowledge of current events (62%), and knowledge of other cultures, countries, or schools (53%). Additionally, WorLD teachers reported a positive impact of computer use on a variety of student attitudes (see Table 11). For instance, 72% of WorLD teachers felt that computers improved student attitudes “a lot” or “a great deal” about learning in school, and 73% rated students high in terms of their improved attitudes with respect to collaborating in groups. WorLD teachers also indicated that their students exhibited improved attitudes about academic subjects (58%) and about themselves as learners (69%).

In summary, a large majority of teachers from the 12 countries agreed that, as a result of their participation in the WorLD program, their students acquired new skills, knowledge, and attitudes.

WorLD Impact in Colombia

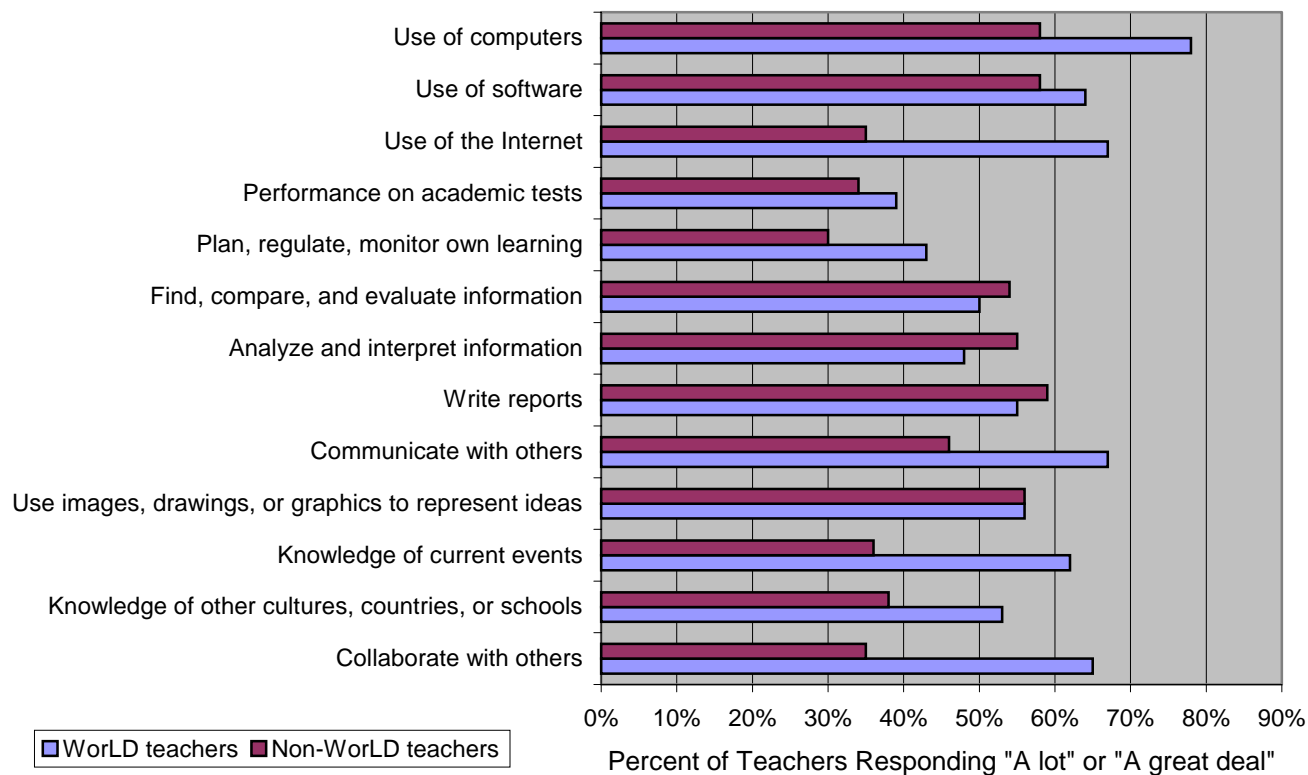
The WorLD Program has had a highly significant impact on Colombian students in a number of areas, particularly with regard to changes in students’ technology skills and attitudes, according to WorLD teachers. For example, 83% of teachers reported a “large” or “great” impact on students’ technology skills, and 79% reported similar impacts on students’ attitudes about technology. Colombia’s score on this benchmark equals the averages of Latin American and WorLD Program countries.

How Did WorLD Students Compare with Other Students?

WorLD teachers reported greater students’ learning and improved attitudes than did non-WorLD teachers in a number of outcomes (Figure 5). WorLD teachers were more likely than these other teachers to say that their students had improved their knowledge about using computers, using the Internet, and communicating with others. WorLD teachers were more likely to report that their students’ knowledge of other cultures and their collaboration with others had increased “a lot” or “a great deal.” They also were more inclined than non-WorLD computer-using teachers to indicate that their students had learned more about current events.

WorLD teachers were also more prone than non-WorLD teachers to report their students’ attitudes about learning in school and their view of themselves as learners had improved “a lot” or “a great deal.” Additionally, they reported that their students’ attitudes toward other cultures and countries had improved (see Table 11). The largest number of WorLD teachers (73%) reported that using computers had greatly improved their students’ attitudes about collaborating in groups.

Figure 5
Teacher Assessment of Impact of Computers on Student Knowledge



In several instances, larger percentages of non-WorLD teachers than WorLD teachers reported that using computers had a great impact on their students' knowledge (see Table 10). These areas were finding, comparing, and evaluating information; analyzing and interpreting information; and writing reports. One possible explanation for these differences may be related to the way ICT is used to develop basic skills. Technology projects that are integrated into the curriculum and are tied to the development of basic skills might also benefit WorLD students in ways other than helping students master technology skills and other career-related competencies. Another potential reason for these differences is that non-WorLD students are

not engaged in as many activities as WorLD students. Because the non-WorLD students are doing less, they may have time, for example, to find, compare, and evaluate information or write reports more often than WorLD students; thus, the impact on student knowledge in these areas may be perceived to be greater by non-WorLD teachers because of the limited nature of how ICT is used in their schools.

A pattern of significant differences between WorLD and non-WorLD schools is also evident when examining implementation variables, such as the frequency with which students use computers. Across a number of measures, WorLD students use computers to perform a variety of tasks more often than their non-WorLD counterparts (see Table 4).

For example, 62% of WorLD teachers reported that their students used electronic mail frequently, compared with 28% of non-WorLD teachers. More than half (59%) of WorLD teachers reported that their students used the Internet an average of “1 to 3 times a month” or “once a week or more,” compared with 26% of teachers in non-WorLD schools.

With respect to collaborative activities using computers, WorLD students, again, used computers more often than their non-WorLD peers. The rate of participation in collaborative projects was significantly different between the two groups, whether the students joined existing collaborations or created their own collaborative projects (see Table 5). More WorLD students than non-WorLD students used computers for collaborating with students in another school and in another country. WorLD students also exchanged information with students in other countries more often than did students in non-WorLD schools. According to teachers surveyed, 63% of WorLD students interacted with others in other countries using computers, compared with 9% of non-WorLD students. WorLD students also were more likely than their non-WorLD peers to join or create collaborative learning activities.

In summary, a majority of WorLD teachers indicated that their students had improved their information, communication, collaboration, and technological skills and attitudes as a result of their participation in the WorLD program. WorLD students used information and communication technology with greater frequency than their non-WorLD counterparts to perform a wide variety of information-gathering and communication tasks. The percentages from WorLD teachers in these areas were significantly higher than

those of non-WorLD teachers. WorLD teachers also reported that their students were more likely to engage in collaborative learning activities than their non-WorLD counterparts.

Did the Program affect boys and girls differently?

One of the characteristics of the modern world is that social and economic disparities exist between males and females. These differences are no less apparent when one considers educational opportunities. Since the 1960s, women’s educational opportunities have expanded considerably, especially in developing countries. According to UNESCO figures (UNESCO, 1999), enrollment of 6- to 11-year-old girls in schools is increasing. Gender differences and behavior have been well documented in both computer use and Internet use by a number of studies (Chen, 1986; Sanders, 1988; Levin & Gordon, 1989; Schofield, 1995; Herring, 1996; Weil & Rosen, 1995; Tannen, 1997). Generally, these studies have found that boys have more positive attitudes about computers than girls. In addition, both boys and girls generally believe that computers belong in the domain of males. These attitudes have contributed to lower enrollments of girls in computer courses and a lower level of interest in computers. A major priority of the WorLD program, therefore, is to promote equitable gender access to technology and learning activities in countries participating in WorLD.

Our evaluation data reveal that there are no disparities between boys and girls in technology access or in the overall effect of the WorLD program. In Year 2, girls comprised 52% of the students involved in the Program. This level of female participation is higher than the non-WorLD female participation of 42%. Female participation can be seen as an indicator of

equitable access to and involvement with ICT in schools. Survey data reveal that girls and boys were acquiring and developing information literacy skills at similar levels. Comparing girls with boys, the vast majority of teachers indicated that there were no differences in terms of the Program's impact (see Figure 6 and Table 13).

African Collaborative Project on HIV/AIDS

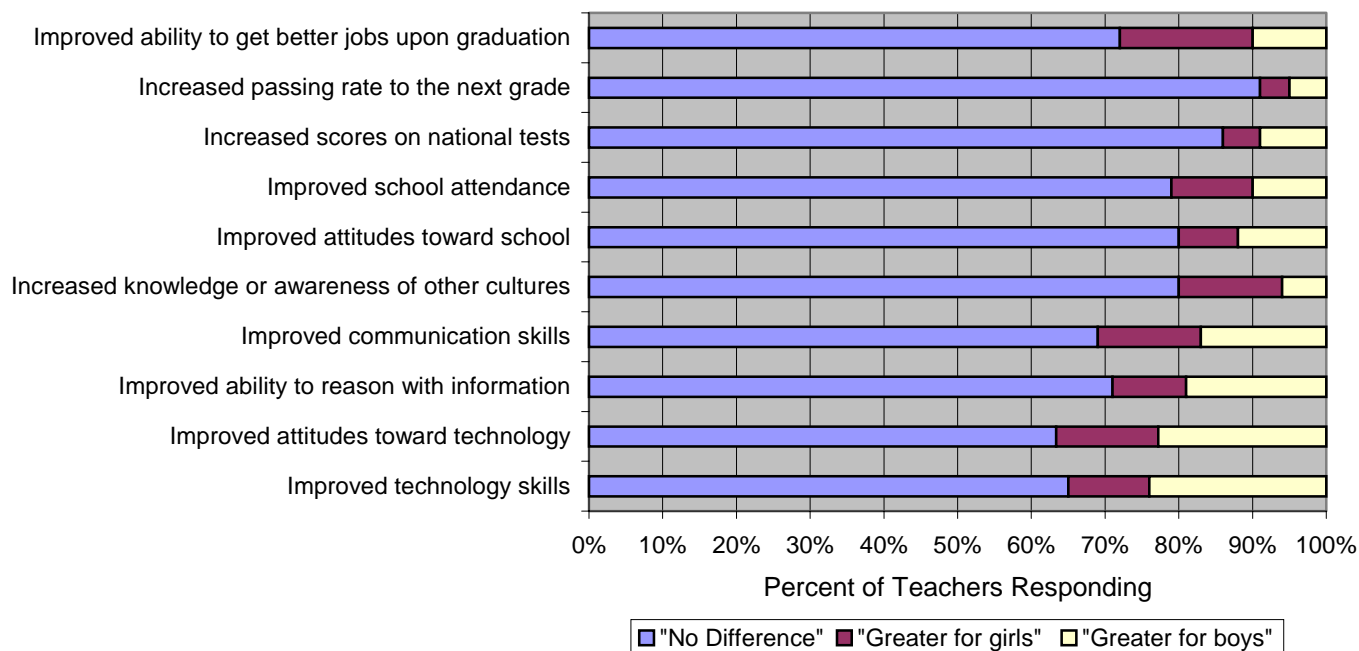
At the start of the year 2000, the WorLD Program, working in conjunction with the World Bank's AIDS Campaign Team for Africa (ACT/Africa), decided to sponsor a collaborative project on HIV/AIDS in Africa. The project, included students from 15 schools in four countries: Ghana, South Africa, Uganda, and Zimbabwe. After enough schools were recruited, introductory questionnaires were sent to participating students and teachers to gauge their level of knowledge about HIV/AIDS. Project activities were designed to promote whole-school involvement, with students and teachers working as a group.

The four goal areas of this collaborative project were to understand:

1. Basic facts about HIV/AIDS
2. The Importance of HIV/AIDS
3. Challenges to HIV/AIDS prevention
4. Social action.

Students and teachers were given guidelines and questions to stimulate discussion and an outline for presenting to the other schools what had been learned while responding to the questions. During the activities, participants went out into their community to collect in-depth information and reported to schools in other countries. Each goal activity lasted about 2 weeks.

Figure 6
Teachers Stating Relative Impact of WorLD Program on Girls and Boys



In summary, the survey data reveal that girls and boys are acquiring and developing a variety of technology and information literacy skills at similar levels. As a result, a major strength of the WorLD program is that it has helped to promote equitable gender access to computers in participating schools. The Program is improving students' attitudes and strengthening academic, communication, and technological skills for both girls and boys.

How did teachers and schools benefit from their participation in the Program?

The rapid pace of change and innovation in applications of the Internet and the World Wide Web has prompted increased interest in understanding how technology can play a role in improving schooling (Bransford, Brown, & Cocking, 1999; Coley, Cradler, & Engle, 1999; Bracewell, Breuleux,

Laferriere, Benoit, & Abdous, 1998; Wenglinski, 1998). Technology-enhanced instruction has been seen by many as promoting change in how teachers teach and how pupils learn. The importance of the role of teachers in school reform and the conditions under which teachers can teach students effectively can provide insight into the ultimate impact of integrating educational technology to support school improvement.

A major component of the WorLD program is its focus on teachers and the supports they need in order to use ICT for collaborative learning. According to the survey results, teachers benefited from the Program's emphasis on professional development and on improved pedagogical practice. Teachers' perceptions of the impact of computers on their own skills were also high on a number of scales (see Table 14). More

than three-fourths (77%) of WorLD teachers indicated that computers helped them “a lot” or “a great deal” to design or prepare projects for students, and 76% believed that computers allowed them to learn more about the subject matter they taught.

In terms of pedagogical skills, computers helped 49% of WorLD teachers “a lot” or “a great deal” to orchestrate teacher-led and student-led discussions, and 61% of WorLD teachers had students work independently as a result of using computers. The promotion of collaborative learning activities is a major goal of the WorLD program, and teaching strategies involving student collaboration were used by a large number of WorLD teachers. For example, 68% of WorLD teachers stated that computers helped them to design or prepare collaborative student projects “a lot” or “a great deal.” Additionally, 64% indicated that using computers has led them to have students work often in groups on collaborative projects.

WorLD Implementation in Peru

Peru's scores on all implementation benchmark themes having to do with classroom activities exceed those of its Latin American and WorLD peers. With regard to introducing student-centered pedagogy, 72% of Peruvian participants reported regularly (1-3 times a month or once week or more) engaging students in student-led discussions, and almost 90% reported regularly having students work independently.

WorLD teachers indicated that using computers has helped them to perform a wide range of tasks more than their non-WorLD counterparts (see Table 14). Larger percentages of WorLD teachers stated that computers have helped them “a lot” or “a great deal” to design collaborative projects, to collaborate with other teachers, to learn more about their subject matter, to engage students in discussion, and to have students



A teacher in Ghana talking to students

work in groups on collaborative learning activities.

Many WorLD teachers felt that their participation in WorLD had helped them to perform a wide range of tasks better (see Table 15). Approximately half of all WorLD teachers felt that the Program had increased their skills in collaborating with teachers in their school on the design of projects for their students. More than 70% of the teachers felt that the Program had greatly improved their ability to use computers and the Internet, and more than 80% indicated that it had improved their attitudes about both technology and their own teaching.

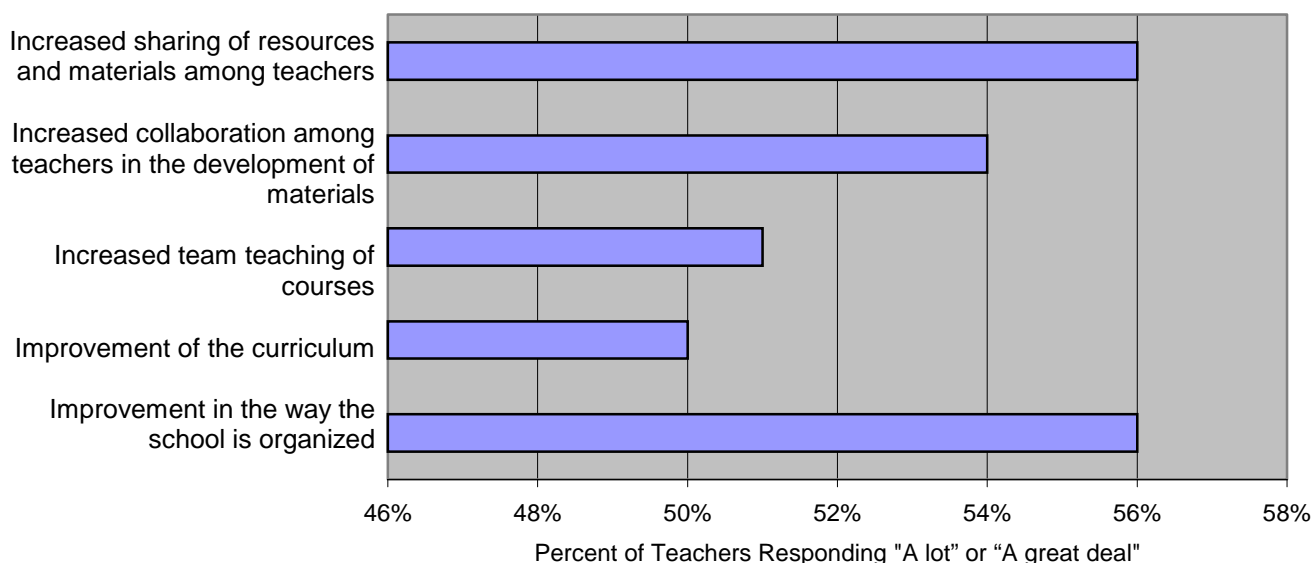
Teachers also reported on the degree to which WorLD had an impact on their schools (Figure 7 and Table 16). More than half (56%) of teachers felt that the Program had increased the sharing of resources and materials among teachers in school “a lot” or “a great deal.” A similar percentage of teachers believed that WorLD had contributed “a lot” or “a great deal” to improvement in the way the school was organized. Increased collaboration among

teachers to develop instructional materials also was highlighted as an impact of WorLD at the school level.

In summary, a large majority of teachers agree that, as a result of their use of computers, they have acquired new skills and attitudes in both technology and pedagogy. Of particular note is the fact that WorLD teachers used computers more often than their non-WorLD peers

to perform a wide variety of tasks, including leading students in collaborative projects. Participation in the WorLD Program has helped participating teachers to improve their skills and their attitudes toward technology and teaching. The Program also had a decided impact on teachers' perceptions of general school improvement activities.

**Figure 7
Impact of WorLD Program on Schools**



How did countries differ in their use of the computer and in its effects?

In terms of teacher and student outcomes, individual countries varied widely across the different survey items related to the impact of computers. Teachers in Chile, Mauritania, and Zimbabwe reported that the impact of computers on student knowledge was great across all 13 indicators of impact on student knowledge. In all countries, large percentages of teachers indicated that

the impact of computers on students' knowledge was considerable in a number of areas (Tables 17a and 18b). For example, large percentages of teachers surveyed in Chile reported that computers greatly increased student knowledge in using computers (91%), using software (81%), writing reports (91%), communicating with others (81%), and knowing about current events (82%). Although there was considerable variation in teacher responses

across the survey items, teachers in all countries reported the greatest improvement in their students' use of computers and software.

There was considerable variation among teachers in both African and Latin American countries regarding the influence of computers on student attitudes (see Tables 18a and 18b). For the most part, these teachers' responses fit no consistent pattern, with Chile, Mauritania, and Zimbabwe reporting that the impact was great across the five indicators of student attitudes. Mauritanian teachers, for example, reported that computers improved student attitudes "a lot" or "a great deal" about learning in school (93%), academic subjects (89%), themselves as learners (93%), other cultures or countries (92%), and collaborating with groups (96%). Relatively few teachers in WorLD countries felt that computers had a great effect on students' attitudes toward other cultures or countries.

Regarding the impact of computers on teacher skills, WorLD teachers reported that the greatest impacts on their own skills were in their ability to design and prepare projects for students, to learn more about their subject matter, and to have students work in collaborative groups (Tables 19a and 19b). Large numbers of teachers from Chile, Colombia, Mauritania, Peru, and Zimbabwe reported that the impact of computers on their own skills was high across nearly all 17 skill categories on the survey. Smaller numbers of Brazilian, Ghanaian, Mozambican, Paraguayan, Senegalese, South African, and Ugandan teachers indicated that using computers had a large impact on their skills.

In summary, WorLD teachers from individual countries varied widely with respect to assessing the impact of computers on their students and their

own skills. Teachers in nearly all countries reported that students' use of computer, software, and the Internet improved as well as their students' ability to communicate with others.

Additionally, teachers in most WorLD countries reported that the impact on them was consistently high across different skill areas.

Benchmark Scoring System

One of the main purposes of the WorLD Evaluation and Monitoring component is to describe the implementation and the impact of the WorLD program in 12 of the 15 countries participating. During the first 2 years of WorLD implementation, the Program has grown and become institutionalized in most of the participating countries. In anticipation of the increasing involvement of local stakeholders in the management and support of WorLD, the Program staff desired to provide a simple tool that might help each country's educators and policy-makers think about Program implementation and impact, relative to countries within their region and within the entire Program. Hence, SRI developed a country scoring system to provide a comprehensive look at the WorLD program by using benchmark categories to gauge performance in and across different countries. This country scoring system allows for comparison of all countries participating in the WorLD program, providing a quick assessment of country performance and a potential tool for managing improvement. The ultimate goal of this system is to provide ministry of education personnel in WorLD countries with a tool to create coherent policies and prepare strategies that might improve the implementation and the impact of the WorLD program.

Country benchmark scores were determined by multiplying the average base score for each survey item (a number from 0 to 4) by its predetermined weighting. The weights for each survey item were determined by the importance of the examined variable to the goals of the WorLD program. Each item’s weighted score was totaled, resulting in an overall score for that particular benchmark category. The weighting system was designed so that each benchmark allows for a maximum score of 100. Below is an example of a survey item and the benchmark score calculation:

1. How much impact has the WorLD Program had on your students’ increased knowledge or awareness of other cultures?

<u>Base Score</u>	<u>Response</u>
0	No impact
1	Small impact
2	Moderate impact
3	Large impact
4	Great impact

In this example, because the maximum base score for this item is 4, the weighting is 25, yielding a maximum weighted score of 100. A base score of 3, then, produces a weighted score of 75. A number of the benchmark themes consist of multiple survey items. In a number of these themes, different survey items have been assigned different weights. Generally speaking, extra weight has been given to survey items that deal with activities and competencies in the areas of group collaboration, cross-cultural awareness, knowledge management, and improved teaching using technology.

Benchmark themes

These categories or themes have been derived from the WorLD Evaluation conceptual framework and survey items in the WorLD teacher survey. A benchmark theme may represent single or multiple survey items. In this section, the implementation and impact benchmark themes are outlined. The following themes were used to frame our analysis of WorLD program implementation and impact.

WorLD Implementation in Mauritania

Eighteen of the 24 Mauritanian teachers reported spending 6 or more hours a week preparing for computer activities, and 22 of 24 teachers reported that students used computers 4 to 6 hours or more a week. The Mauritanian average score on this Item Using ICT benchmark is well above the African and WorLD Program averages. One possible explanation for these high levels of ICT use is the presence of high-speed leased lines connecting WorLD schools to the Internet.

Implementation Benchmark Themes

Teacher Training Support Received – A lack of training is commonly cited as a major obstacle hindering teachers from integrating technology. This benchmark captures the variety of training support received by WorLD teachers in a particular country.

Teacher Training Support Given to Other Teachers – This benchmark describes the degree to which WorLD-trained teachers informally share their skills in using technology with other teachers in their school.

ICT Access – Student-to-computer ratios are useful measures of the degree of student access to educational technology. For this benchmark, the student-to-computer ratio is calculated by school and then aggregated across WorLD schools for a particular country.

Time Using ICT – A functional measure of the degree of technology use is the amount of time participants use computers. This benchmark includes variables describing the amount of computer use by WorLD teachers and students during a typical week and throughout the school year.

Nature of ICT Use – How computers are used and for what purpose is the focus of this benchmark category. ICT can be used in simple ways and in complex ways. The differential weights for each item reflect and distinguish between complex uses requiring open-ended exploration and analysis and using computers to perform simple, discrete tasks.

Student-Centered Pedagogy – One of the aims of the WorLD program is to foster improved teaching and learning using technology. This benchmark gauges to what extent WorLD teachers are using instructional practices that encourage students to take responsibility for their own learning.

Cognitively Complex Learning Activities – This benchmark describes the kinds of student activities that engage students in complex learning tasks (as opposed to mechanistic or rote learning activities). These activities engage students with subject matter and promote greater collaboration among students and teachers.

Collaboration – An important mission of the WorLD program is to promote greater collaboration within schools and across different countries. This benchmark theme includes the amount of collaboration among students, as well as the degree of collaboration among teachers.

Gender Participation – Given the importance that all students be served by the WorLD program, participation of girls in WorLD schools is an important indicator of broader gender involvement. This percentage is determined by the teachers' estimates of the percentage of females in their class or club.

Impact Benchmark Themes

Student Technology Skills and Attitudes – This theme examines the impact of the WorLD program on improved student technology skills and on their attitudes toward using technology.

Student Communication and Information Reasoning Skills – The WorLD program seeks to promote skills that will equip students for the digital age of the 21st century. This benchmark describes information processing and communication skills that have been affected by participation in the WorLD program.

Student cultural awareness – Cross-cultural exchange activities and collaboration in WorLD are likely to influence a student’s awareness of cultures apart from his or her own culture. This theme reflects the influence of WorLD on students’ attitudes toward different cultures.

Student School Attitudes – Participation in the WorLD program may have an effect on the attitudes students have toward schooling in general. This theme describes the impact of WorLD on students’ school attitudes.

Impact of WorLD on Girls – This benchmark theme describes the impact of the WorLD program on girls versus boys. A lower score indicates that the impact was greater for boys; a higher score indicates that the impact of the program was greater for girls.

Teachers’ Technology Skills and Attitudes – Teachers are bound to develop new skills and beliefs about ICT through WorLD participation. This benchmark gauges the impact of WorLD on their technology skills and attitudes.

Teachers’ Pedagogical Skills and Attitudes – This benchmark will provide a measure of how the WorLD program influenced teachers’ instructional practices, as well as their attitudes toward teaching.

Teachers’ Perception of Student Potential Employability – This benchmark seeks to gauge the potential employability of WorLD students based on teachers’ assessments.

WorLD country comparisons

To look globally at WorLD implementation and impact, each country’s benchmark scores in the relevant benchmark categories were totaled and averaged to create indices of WorLD implementation (see Figure 8) and WorLD impact (Figure 9).

Additionally, country benchmark indicators for student technology skills, student communication and reasoning skills, collaboration, and teachers’ perceptions of potential employability were combined and averaged to create country indices for student potential employability (Figure 10).

Examining each of these figures, one gets a global sense of how the implementation of WorLD classroom activities is progressing in each country, what is the perceived impact of the Program in each country, and how perceptions of student employability vary. Four countries’ implementation indices are above the WorLD mean, and the remaining countries fall below the WorLD average. Looking at the impact indices, seven countries are at or above the WorLD average, and five countries are below the WorLD average.

**Figure 8
Implementation Indices, by Country**

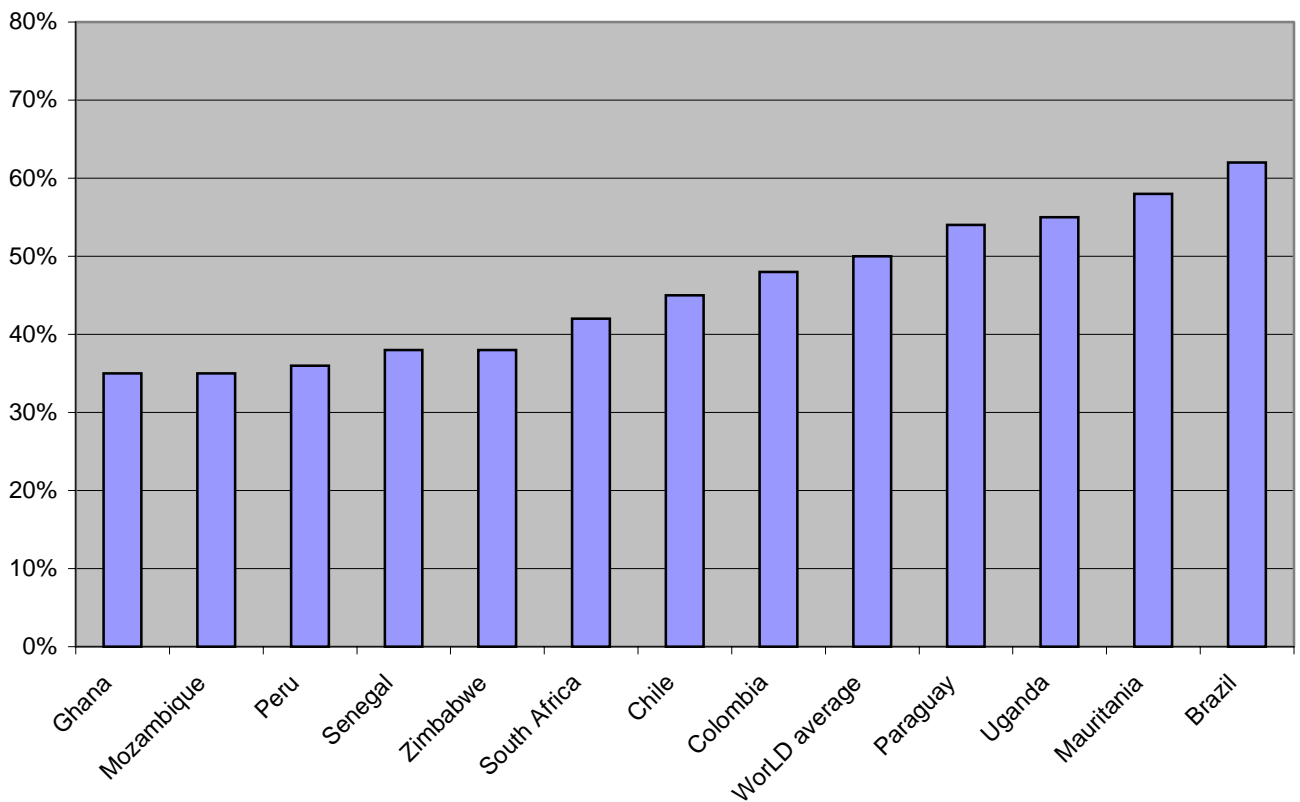


Figure 9
Impact Indices by Country

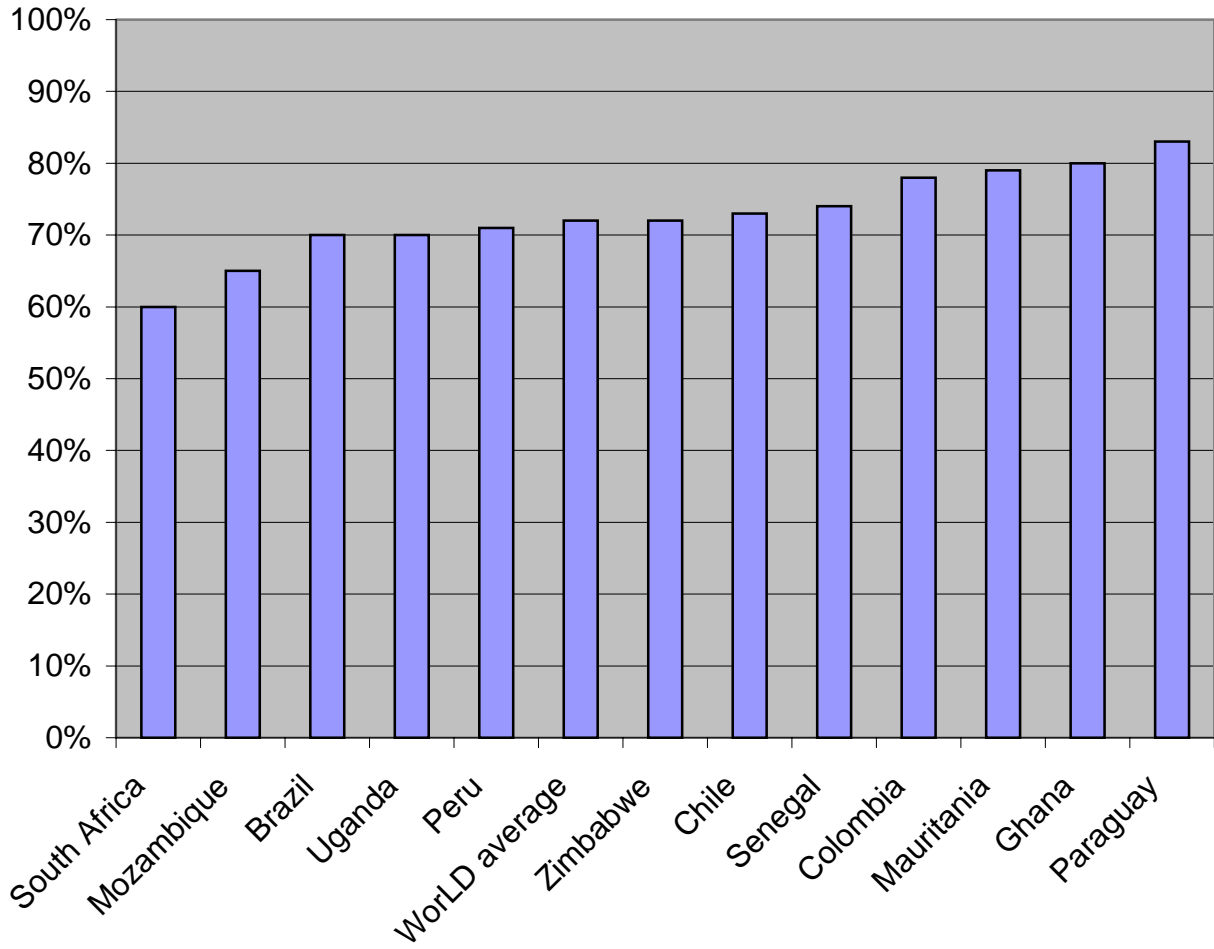
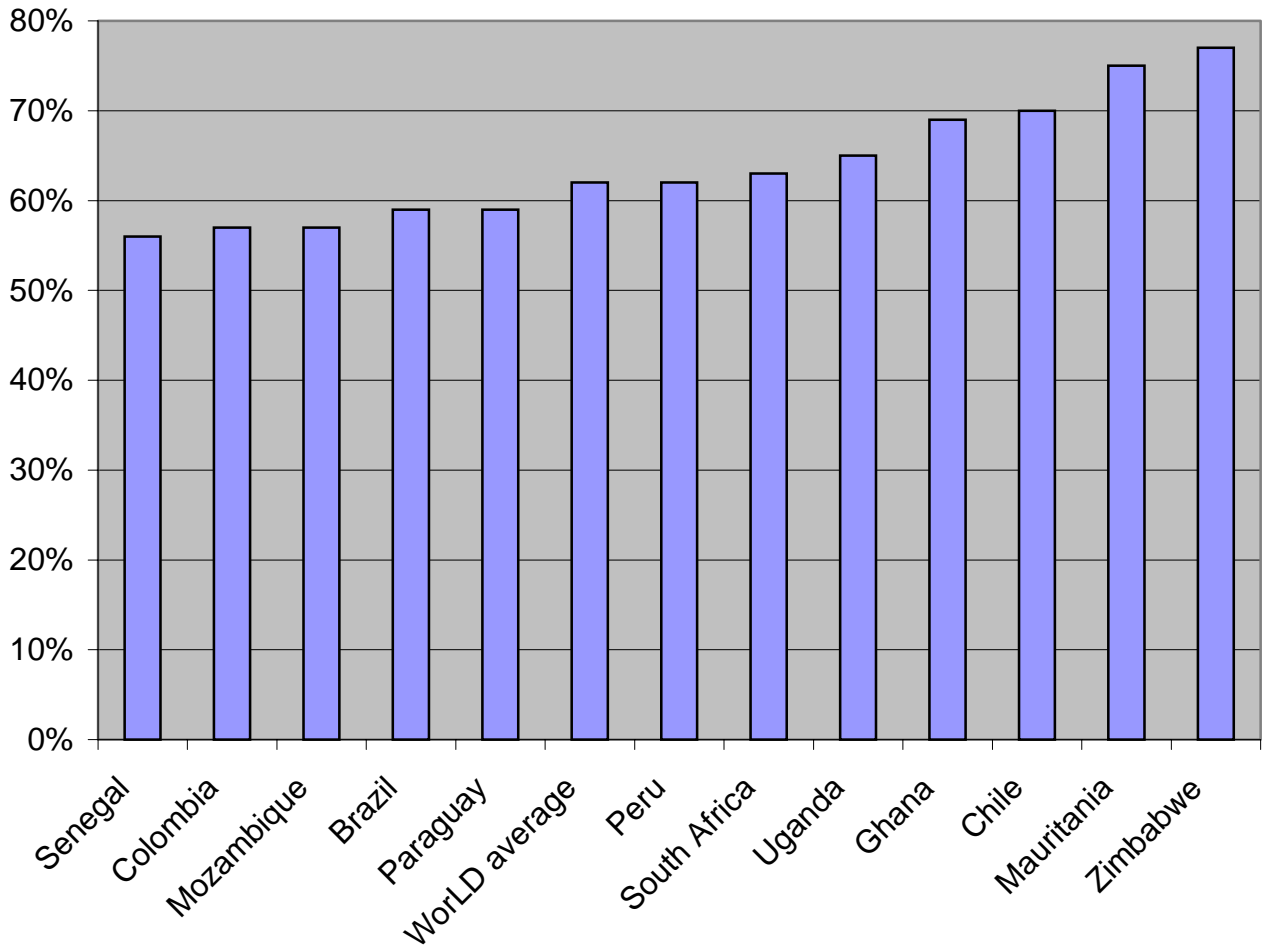


Figure 10
Potential Student Employability Indices, by Country



These indices provide a good picture of the impact of the WorLD program after two full years of implementation. The impact of WorLD is being felt in all countries, notwithstanding the many challenges countries face in addressing systemic change in their educational systems. As emphasized earlier, using the benchmarks to compare all countries participating in the WorLD program provides a quick assessment of country performance and a useful tool for gauging progress. These comparisons are not intended to rank or to produce a hierarchy of status based on teacher survey responses. Rather, it is hoped that these indices provide a basis for identifying strategies and plans that may be pursued to improve Program implementation in each country.

Summary and Recommendations

In its second year of operation, the WorLD program has made considerable strides in cultivating pockets of innovation using ICT to improve education. Program implementation has picked up momentum, and many countries are expanding the Program to different schools. The Program has done much to help build capacity among local educators and energize a cadre of teachers to rethink how technology can enhance their pedagogical practices and engage students in collaborative learning activities. Large numbers of students in WorLD schools are participating in collaborative projects, and these projects are proliferating in all the participating countries. And with the creation of a World Links Organization, participating countries in Africa are receiving additional support to align Program activities with the efforts of local ministries of education.

The WorLD program also has had a significant impact in schools and classrooms in a number of countries. The use of ICT

has resulted in improved skills, knowledge, and attitudes among students and teachers alike. According to their teachers, WorLD students use ICT more often than their non-WorLD counterparts. A large majority of WorLD teachers also reported that there are no major differences in the Program's impact on girls and boys. And, as a result of their participation in WorLD, teachers indicated that not only have they acquired new skills and attitudes that have affected classroom instruction, but the Program has had an impact on their schools so that ICT can be used more effectively.

Although the WorLD program is helping to improve capacity to use ICT effectively in participating countries, numerous challenges remain that should be addressed if the Program is to grow and expand. There is much that WorLD can do to address these challenges and maximize Program improvement. However, the role of the national ministries of education (MOEs) is critical in this regard. Without additional leadership, vision, and additional funding, the investment and the impact made thus far by WorLD may be lost over time.

Our recommendations are based on our analysis of the survey data, which includes teachers' perspectives on barriers to Program implementation. The recommendations, directed to WorLD program staff and MOEs, address four major areas:

- Technology access
- National policy and vision for ICT
- Professional development
- Organizational structures and supports for teacher learning

Technology access

In a pattern similar to last year's results, this year's findings show that a majority of teachers in African and Latin American countries reported that the lack of adequate

hardware and software and unreliable Internet access were significant barriers to using computers in instruction. Barriers such as these should be addressed creatively if the Program is to be sustained over the short term. The recommendations that follow are based on addressing these barriers systemically, from the Program's perspective and from the local ministry of education's perspective.

To address technology access and infrastructure barriers, the WorLD program should engage in strategic planning, create new funding schemes, and consider the use of new technologies (e.g., wireless solutions) in their efforts to improve technology access, reliability, and flexibility.



Students in Chile connecting to the Web

Recommendation 1: Work with MOEs to develop a strategic plan to address technology needs. Schools in WorLD countries have amassed a critical mass of equipment, networking technologies, and software. However, as indicated previously, many of these resources are inadequate to allow the implementation of computer-enhanced instruction. Heading into the third year of the Program, it is likely that many schools are using old and outdated equipment. It will be necessary to develop a strategic plan that addresses equipment needs and replacement as older equipment deteriorates. This planning, however, should not occur in isolation from the local

ministry of education. The Program and local ministry officials together should consider the local country context, available resources, formulas for equity, and the goals and objectives for using technology to improve education when planning for future needs.

Recommendation 2: Collaborate with MOEs to identify continuous funding sources to purchase new computers. In addition to planning, it will be important to maintain a growing stream of funding for purchasing newer computers, better software, reliable networking technologies, and dependable Internet connectivity. Funding is a major challenge in countries where little discretionary spending occurs. To sustain the use of ICT on a large scale, it may be necessary to reconfigure budgets to fund the implementation of new technologies (Dede, 1997). Without such shifts in financing, it will be difficult to sustain innovative instructional approaches using ICT. Policy-makers should be willing to consider new and creative ideas and exercise a range of political skills to advocate for new budget allocations and generate additional resources. A mixture of self-supporting, entrepreneurial activities and public-private funding may be necessary to obtain additional funds to stave off equipment obsolescence.

WorLD in Mozambique

The WorLD project in Mozambique is a partnership between WorLD, the Mozambique Ministry of Education, the Eduardo Mondlane University, and the IDRC/Acacia project. The goal, of course, is to connect schools. Four teachers from each of the 10 schools (pre-university institutes or training colleges) participated in computer literacy training workshop in June 1998, and the first WorLD workshop took place in September 1998. The WorLD schools are located in Maputo, Beira, Nampula, and Quelimana.

Recommendation 3: Harness new technologies to improve the delivery of training and Internet access. In a world where technological advances occur in leaps and bounds, it will be important for the WorLD program to harness the latest innovations, not only to improve the delivery of its professional development training but also to help schools use these new technologies to improve teaching and learning. One innovation that might help in both areas is wireless networking and connectivity. Many of the schools in participating countries have older buildings that are not amenable to major renovations such as copper wiring. Wireless technology can help to provide reliable networking and connectivity in such environments. Videoconferencing and Web-based distance learning also should be considered as replacements or complements to face-to-face teacher training workshops. Almost every WorLD country identified inadequate Internet access as hindering the use of ICT for instruction. Noteworthy among the WorLD countries, however, was Mauritania, where only a small minority of teachers mentioned that unreliable Internet access was a major barrier (see Table 7). One reason for this finding is that authorities there employ dedicated leased lines with wide-bandwidth access to the Internet that WorLD schools may use 24 hours a day, 7 days a week. In all countries, joint plans will have to include a strategy for providing affordable, high-speed access to all schools within the Program. Partnering in this area between the WorLD program and ministries of education will be necessary to identify additional funding to make technology readily available and accessible for everyday teaching and learning.

National policy and vision for ICT

A number of WorLD teachers in different countries stated that the lack of a national policy on technology use in schools was a major barrier to using computers in their classrooms. The Year 1 evaluation report (Kozma et al., 1999) recommended that national policies be coordinated to eliminate any conflicts between local practices and the WorLD program.

To facilitate this process of coordinating and formulating a strong national policy on ICT use, the WorLD program should develop strong national policies outlining the role of ICT and establish mechanisms that strengthen the role of teachers to better use technology in innovative ways.



Ghanaian teachers in workshop

Recommendation 4: Encourage MOEs to take a proactive leadership role in developing a national policy on ICT.

Although there seems to be a great deal of enthusiasm for technology among educators and students in WorLD schools, may not be clear to these WorLD participants. In a number of countries, sizable numbers of teachers stated that a major barrier was the lack of a national policy about the role of ICT in education. This issue can be addressed best at the national policy level. Policy-makers should form forward-looking visions of how technology fits into their countries' social and economic goals and actively direct schools toward that vision. Typically, policy statements and the

articulation of funding goals and priorities can communicate the vision to the education sector. Articulating a vision for the use of ICT in education and linking it with national goals and standards have highlighted the importance of technology in education in a number of countries. The WorLD program could be a part of this vision, with its focus on teacher training and educational content. The creation of competitive grant programs that provide funds to develop new prototypes for using ICT in teaching and learning have also proven to be effective in raising the visibility of important priorities. Policy-makers in WorLD countries should exercise proactive leadership and initiate bold steps to implement their vision for ICT in education.

Recommendation 5: Offer strategies to implement national policies and offer incentives to strengthen teacher commitment to Program goals.

Articulating the vision and seeing it applied in practice is a major challenge. Not only should teachers see the value of incorporating new pedagogical practices, they ought to be motivated to invest additional time in mastering new technologies. First, ministries of education should make a case to teachers of the value of using ICT to improve teaching and learning. They should disseminate information culled from recent research, at home and abroad, about the benefits of using ICT and the classroom and school conditions that create an environment for using ICT effectively. Second, there should be a realignment of curriculum development, assessment practices, and teacher professional development that stems from the vision. This effort, perhaps, will be the most difficult. Indeed, this recommendation is similar to one offered in the evaluation report from Year 1 (Kozma et al., 1999). Coordination between the

WorLD program and ministry of education staff should continue so that the goals of WorLD are aligned with the national educational goals. If this coordination does not occur, teachers will have no incentive to invest time in mastering the use of ICT in their classrooms.

WorLD in Chile

Chile is one of the original four WorLD pilot countries in Latin America. The Program has the support of the Enlaces Program on Educational Technology, which was developed by the Chilean Ministry of Education under the auspices of the Universidad de la Frontera. Fifteen public schools have been selected for the initial phase of the project, located in diverse regions of the country (Arica, Santiago, Los Angeles, Concepcion, Temuco, Valdivia, Osorno, Puerto Montt, Chiloe, and Punta Arena). The selected schools have from 1 to 4 years of working with information and communication technology. Project leaders have introduced Phase I and II international training through several local workshops, and, thus far, more than 290 teachers have received training and more than 50 collaborative projects have been completed.

Professional development: Provide continuous learning opportunities

Current research on professional development stresses a shift away from the traditional model of one-time workshops toward teacher learning experiences that are ongoing. Meaningful professional development views teachers as continuous learners who need opportunities to reflect and collaborate in teacher teams to discuss student work, plan challenging lessons, and problem-solve about issues relevant to their immediate school context (Darling-Hammond & McLaughlin, 1995; Lieberman, 1995; Little, 1993). The workshops themselves are less lecture oriented and use more hands-on, interactive

techniques. Ideas and strategies are modeled, and teachers actually participate in the type of work (e.g., collaborative group projects) they ask of their students (Harris, 1994). Effective professional development offers follow-up support and observations after training sessions to help teachers implement new strategies in their classrooms and reflect on their practice. This type of continuous support and feedback is essential to strengthen and sustain new practices and improve student learning (Calderon, 1994; Darling-Hammond & McLaughlin, 1995; Ringstaff & Yocum, 1994). This is especially true for technology training. Because technology changes rapidly, professional education in technology should be approached as an ongoing need (Caverly, Peterson & Mandeville, 1997).

To provide more ongoing professional education for the WorLD teachers, WorLD program and MOEs should provide teachers with more professional education on technology integration on an ongoing basis through follow-up coaching, a teacher on-line network, peer coaching, and schoolwide professional development.

Recommendation 6: Assign technical support staff to help teachers implement curriculum objectives and provide technical support. Studies and reports on education technology repeatedly stress the importance of on-site computer assistants to the successful integration of technology into curricula (The Benton Foundation, 1995, cited in Levin, 1996; National Association of Secondary School Principals, 1996; Hancock, 1997). A technology resource person would help teachers troubleshoot computer glitches, review software capabilities, and find materials and information they need to design integrated curriculum lessons. This technical aide should also attend all WorLD professional

development sessions to learn about integrating technology into the curriculum and other WorLD program goals.

Recommendation 7: If feasible, assign a WorLD staff trainer to provide follow-up coaching to teachers. This support member could observe teachers implementing cooperative group projects, offer feedback on instructional goals, lessons, and assessments, and problem-solve on logistical, technical, and other implementation issues. Again, follow-up support is critical to helping teachers effectively implement technology in their classrooms (Benton Foundation, 1995; Ringstaff & Yocum; Harris, 1994, - cited in Levin, 1996). The fact that only 25% of WorLD teachers are serving as teacher trainers at their schools suggests that many may not yet feel prepared to assume a training role. On-site support and feedback might offer the additional information and assistance they need to act as future mentors and trainers to their peers. Another promising model of providing technical support is to develop technical expertise among students. With planning, formal training, and supervision, cadres of students could work together to provide teachers with technological support. Students could earn



African teachers getting connected

academic credit and other forms of school recognition for their service. Moreover, they would gain valuable experience and skills for future employment. Cultivating student experts also would be more cost-

effective than contracting outside technical support.

Recommendation 8: Create a WorLD teacher on-line network to allow teachers to problem-solve and share strategies, challenges, and best practices. In addition to site-based professional development, WorLD teachers would benefit from a regular on-line support network to share ideas and best practices. Implementing technology initiatives can be a daunting and confusing task for many teachers. A professional network would provide peer support and ongoing opportunities for professional growth and self-evaluation (Lieberman, 1996). For example, teachers within and across countries, for example, could discuss daily challenges with technology integration, share ideas for collaborative lessons, and discuss how best to assess student performance. Informal retreats and dinner gatherings in a relaxed environment can be added incentives for educators to get together to discuss topics of immediate concern and interest (Lieberman, 1996).

Recommendation 9: In addition to peer professional support, the WorLD program may want to develop an on-line professional development site. WorLD teachers could access this site to ask WorLD staff members questions about Program implementation, technology-related issues, curriculum, assessment, and other daily implementation challenges. Information delivered at the WorLD training conferences, as well as materials, conference notes, and transcripts of presentations, also could be placed on-line. Education technology companies also are emerging that offer on-line professional development courses and support. It would be worthwhile researching these new ventures to determine whether on-line professional education programs—in addition to training

conferences—would be appropriate for WorLD teachers.

Recommendation 10: Encourage schoolwide professional development. Research shows that, to some degree, effective professional development involves everyone at the school in learning activities (Darling-Hammond & McLaughlin, 1995). When implementing technology initiatives, it is important to train technical resource staff, librarians, and principals in addition to teachers. When all key staff members receive professional education, a community of continuous learning, collaboration, and support is created. It is also important, if possible, to request that schools send teams of teachers to workshops who can work together to implement new strategies when they return to their schools (Caverly, Peterson, & Mandeville, 1997; Harris, 1994; Ringstaff & Yocum, 1994).

Involving principals in professional education is especially important. As several reports on education technology note, when principals are knowledgeable about the initiative and are onboard, they play a key role in offering vital support to help implement technology programs (Harris, 1994; Levin, 1994; Ringstaff & Yocum, 1994; National Association of Secondary School Principals, 1996). The WorLD program also should request that staff from the MOEs attend training sessions to educate and encourage support from all levels of the educational system.

Professional development: Focus content on technology integration

Many WorLD teachers expressed a lack of knowledge of how to integrate technology into the wider curriculum. The majority reported that technology was used primarily for computer science projects and to develop specific computer skills. This limited use of technology in the broader curriculum also is an issue in other countries. The technology itself, however, is not to blame. Rather, support and high-quality professional education are needed that show teachers how to integrate technology into their instruction and into their students' learning processes (Caverly, Peterson, & Mandeville, 1997). When teachers want to go beyond using computers as word processors or for data input, they face a huge learning hurdle.

Recommendation 11: Emphasize interdisciplinary, comprehensive curriculum integration, and tie technology to development of basic skills.

The use of technology should be aimed at helping students develop a variety of skills and competencies through engagement with subject area content. Studies have shown that technology education programs, such as electronic student learning networks, are most effective when tied directly to the broader curriculum and to the development of basic skills (Levin, 1995; Thirston et al., 1996). Teacher education should model how to develop interdisciplinary technology projects. Collaborative projects that, for example, draw on math, science, and social studies themes and also are designed to strengthen students' reading, writing, and analytical skills should be presented and analyzed.

Recommendation 12: Review the entire curriculum integration process to provide teachers with practical, specific strategies.

WorLD teachers need guidance on how to take technology beyond computer science to the wider curriculum. They need, however, concrete models and strategies to understand what this expansion looks like and how they can make it happen. During teacher training, the entire lesson design process should be reviewed, including identifying student learning goals, designing the interdisciplinary unit, and integrating technology into the lessons.



Teacher with students in South Africa

Organizational structures and supports for teacher learning

In addition to opportunities for continuous professional education, teacher learning requires school-based organizational supports and structures. As research has shown, teachers are more committed and effective when they feel supported in their learning and in their practice (Darling-Hammond, 1996; Haggstron et al. 1998; McLaughlin and Talbert, 1993; Rosenholtoz, 1989).

1. Effective and knowledgeable leadership (by principals); meaningful context-specific teacher evaluations
2. Scheduling and creating time for teacher collaboration
3. Team teaching arrangements
4. Peer observation, mentoring
5. Adequate support staff

Recommendation 13: Stress the key role that principals play in creating a context for teacher learning and effective Program implementation. Principals play a key role in creating a culture of professional learning within schools and in implementing initiatives to meet student achievement goals. Principals who see professional growth as central to student achievement develop the supports and structures needed to promote teacher learning and therefore good teaching (Darling-Hammond & McLaughlin, 1995). In schools implementing technology initiatives, support from administrators is as important as technical support. Ultimately, it is the principal who often makes key decisions regarding release time, team teaching arrangements, and access to technology materials (Harris, 1994; Levin, 1995; Ringstaff & Yocum, 1994).

Recommendation 14: WorLD principals should be involved in WorLD training and all follow-up discussions regarding how to reform organizational structures, revise school schedules, and use resources to create time for teacher collaboration. Through WorLD training, principals may also discover that they need to evaluate WorLD teachers differently. Integrated technology projects change the nature of teaching and learning. Principals may need to focus less on assessing direct instruction techniques and focus more on evaluating teachers as facilitators of student-centered, interactive projects. More specific and knowledgeable evaluations would provide WorLD teachers with additional feedback on implementing Program goals.

WorLD in Ghana

Ghana's WorLD project began in May 1997 as a pilot effort to provide connectivity and training for students and teachers at four senior secondary schools in Accra. The training focused on concrete applications of IT to help achieve existing curricular objectives in language arts, sciences/math, and social studies. The pilot schools engaged in cultural exchange projects with schools in Illinois and Canada to share research and writing projects via electronic mail and to develop collaborative Web sites. Later, in the fall of 1997, a second cohort of 10 schools from Kumasi, Cape Coast, Tema, and Aburi were selected, and WorLD training was conducted for students, teachers, and headmasters from all 14 schools. Since October 1997, 181 teachers have attended four training workshops.

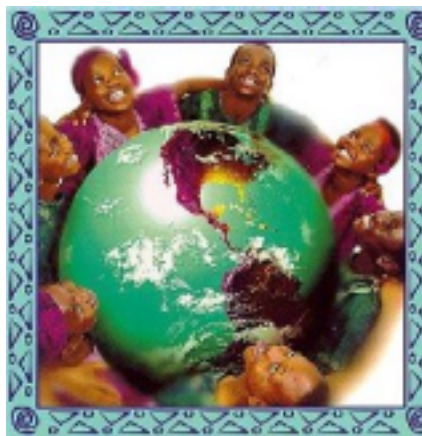
Recommendation 15: Create time and structures to support teacher collaboration and implementation of high-quality programs. Time is the key to teacher professional growth. Time is needed for ongoing teacher collaboration, reflection, and planning (Calderon, 1999; Darling-Hammond & McLaughlin, 1995; Lieberman, 1995; Little, 1993). Schools in other countries are beginning to creatively restructure school schedules to allocate more time for coordinated teacher planning and discussions. During WorLD training sessions and in follow-up meetings with teachers, principals, or MOE staff, provide ideas and strategies for creating new time structures and supports. Program staff should allow participants to brainstorm ideas and plans that would work best in their school contexts. Some examples of organizational supports and structures used in other countries are:

1. *Team teaching* arrangements that support teacher coordination and planning and allow teachers to observe their peers, share ideas, and give feedback on lesson implementation.
2. *Release time* and teacher coverage for planning lessons or observing peers.
3. *Lengthening class periods (block scheduling)* to offer teachers more time to implement more in-depth and interactive collaborative projects. Block scheduling also may give teachers longer shared planning periods to design lessons, share ideas, and reflect on their practice.
4. *Early student release days* one day a week or month to provide teachers with additional planning time. Some schools do this by starting the school day 10 or 15 minutes earlier to accrue time for these monthly early release days.

Conclusion

The WorLD Program has made significant progress during its second year of operation. WorLD implementation in each country is growing and evolving, building upon past successes to enhance the capacity of teachers while providing the supports necessary for successful teaching and learning using ICT. Survey respondents during the 2nd year of the Program all identified improvements in learning for both students and teachers as a result of the WorLD Program. Although WorLD is a relatively young program, these findings suggest that the Program is strong and robust.

To fully use technology as a means to improve schools and prepare children for employment in the 21st century, the WorLD program, working with each country's ministry of education, will need to think strategically about how to utilize scarce resources to achieve these aims. This second-year report identifies a number of important challenges and offers targeted recommendations that can provide guidance on how to sustain the WorLD program and strengthen the prospects for continued success in the future.



References

- Becker, H. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, 26(3), 291-320.
- Becker, H., & Riel, M. (1999). *Teacher professionalism, school work culture and the emergence of constructivist-compatible pedagogies*. Irvine, CA: University of California.
- Berman, E. (1999). The political economy of educational reform in Australia, England and Wales, and the United States. In R. Arnove & C. Torres (Eds.), *Comparative education: The dialectic of the global and the local* (pp. 257-282). New York: Rowman & Littlefield.
- Bransford, J.; Brown, A.; & Cocking, R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academic Press.
- Bracewell, R.; Breuleux, A.; Laferriere, T.; Benoit, J. & Abdous, M. (1998). *The emerging contribution of online resources and tools to classroom learning and teaching*. (<http://www.tact.fse.ulaval.ca/ang/html/rev98es.html>)
- Calderon, M. (1994). Mentoring, peer coaching, and support systems for first-year minority/bilingual teachers. In R.A. DeVillar, C.J. Faltis, and J.P. Cummins (Eds.). *Cultural Diversity in schools: From rhetoric to practice*, 117-141. Albany, NY: State University of New York Press.
- Calderon, M. (1999). Teachers Learning Communities for cooperation in diverse settings. *Theory Into Practice*, (38)2, 94-99.
- Caverly, D., Peterson, C., & Mandeville, T. (1997). A generational model for professional development. *Educational Leadership* (55), 3, 56-59.
- Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, (2), 3, 265-282.
- Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Harvard University Press.
- Coley, R.; Cradler, J. & Engle, P. (1999). *Computers and classrooms: The status of technology in U.S. schools*. Princeton, NJ: ETS.
- Collins, A., Brown, J., & Newman, S. (1989). Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics. In L. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Erlbaum.
- Darling-Hammond, L. (1996). The quiet revolution: Rethinking teacher development. *Educational Leadership*, (53) 6, 4-10.
- Darling-Hammond, L., & McLaughlin, M.W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, (76) 8, 597-604.
- Dede, C. (1997). Rethinking how to invest in technology. *Educational Leadership* (55), 3, 12-16.
- Fullan, M. (1991). *The new meaning of educational change*. New York: Teachers College Press and London: Cassell.
- Fullan, M. (1993). *Change forces: Probing the depths of educational reform*. London: Falmer Press.

- Hancock, V. (1997). Creating the information age school. *Educational Leadership* (55), 3, 60-63.
- Harris, J. (1994). Teaching teachers to use telecomputing tools. *The Computing Teacher* (22), 3, 60-63.
- Herring, S. (1996). Posting in a different voice: Gender and ethics in computer-mediated communication. In C. Ess (Ed.), *Philosophical approaches to computer-mediated communication* (pp. 115-145). Albany: SUNY Press.
- Huberman, M. (1992). Critical introduction. In M. Fullan (Ed.), *Successful school improvement*. Buckingham: Open University Press and Toronto: OISE Press.
- International Society for Technology in Education (ISTE). (2000). *National educational technology standards for students: Connecting curriculum and technology*. Eugene, OR: Author.
- Kozma, R., & Schank, P. (1998). Connecting with the twenty-first century: Technology in support of educational reform. In C. Dede (Ed.), *Technology and learning*. Washington, DC: American Society for Curriculum Development.
- Kozma, R., McGhee, R., Marder, C., Baisden, K., Valdes, K., Lewis, A., & Agreda, M. (1999). *World Links for Development: Accomplishments and challenges: Monitoring and Evaluation Annual Report, 1998-1999*. Menlo Park, CA: SRI International.
- Levin, J. & Thurston, C. (1996). Educational electronic networks. *Educational Leadership*, (54), 3, 46-49.
- Lieberman, A. (1995). Practices that support teacher development. *Phi delta Kappan*, (76), 8, 591-596.
- Lieberman, A. (1996). Creating intentional learning communities. *Educational Leadership*, (54), 3, 51-55.
- Little, J. W. (1993). Teachers' professional development in a climate of education reform. *Educational Evaluation and Policy Analysis*, 15(2), 129-151.
- McConnell International. (2000). *Risk e-business: Seizing the opportunity of global e-readiness*. Washington, DC: Author.
- McLaughlin, M. (1993). What matters most in teachers' workplace context? In J. Little & M. McLaughlin (Eds.), *Teacher's work: Individual, colleagues, and contexts* (pp. 97-123). New York: Teachers College Press.
- McLaughlin, M.W. and Talbert, J.E. (1993). New visions of teaching. In D.K. Cohen, M.W. McLaughlin, and J.E. Talbert (Eds). *Teaching for Understanding: Challenges for Policy and Practice*.
- Means, B., & Golan, S. (1998). *Transforming teaching and learning with multimedia technology*. Menlo Park, CA: SRI International.
- Means, B., & Olson, K. (1997). *Technology's role in education reform: Findings from a national study of innovating schools*. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.
- National Association of Secondary School Principals. (1996). *Breaking Ranks: Changing and American Institution*. Reston, VA.: NASSP.

- O'Day, J., & Smith, M. (1993). Systemic reform educational opportunity. In S. Furman (Ed.), *Designing coherent education policy: Improving the system* (pp. 250-312). San Francisco: Jossey-Bass.
- Quellmalz, E., & Zalles, D. (1999). *World Links student assessment: 1998-1999 Report*. Menlo Park, CA: SRI International.
- Resnick, L. (1987). *Education and learning to think*. Washington, DC: National Academy Press.
- Ringstaff, C. & Yocum, K. (1994). *Creating an alternative context for teacher development: The ACOT teacher development centers*. Cupertino, CA: Apple Computer, Inc.
- Rosenholtz, S. (1989). *Teacher's Workplace The Social Organization of Schools*. New York: Longman.
- Sandholtz, H., Ringstaff, C., & Dwyer, D. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.
- Schofield, J. (1995). *Computers and classroom culture*. New York: Cambridge University Press.
- Stoll, L., & Fink, D. (1996). *Changing our schools*. Buckingham: Open University Press.
- Totten, S., Sills, T., Digby, A., & Russ, P. (1991). *Cooperative learning: A guide to research*. New York: Garland.
- UNESCO (1999). *UNESCO statistical yearbook, 1999*. Lanham, MD: Bernan Press.
- Voogt, J. M., & Odenthal, L. E. (1997). *Emergent practices geportretteerd: Conceptueel raamwerk [Emergent Practices Portrait: Conceptual Framework]*. Enschede, The Netherlands: University of Twente, Faculty of Educational Sciences and Technology.
- Voogt, J. M., & Odenthal, L. E. (1999). Met het oog op de toekomst: Een studies naar innovatief gebruik van ICT in het onderwijs [With a view to the future: A study of innovative use of ICT in education]. Enschede, The Netherlands: University of Twente, Faculty of Educational Science and Technology.
- Weil, M., & Rosen, L. (1995). The psychological impact of technology from a global perspective: A study of technological sophistication and technophobia. *Computers in Human Behavior, 11*, 95-133.
- Wenglinski, H. (1998). *Does it compute?: The relationship between educational technology and student achievement in mathematics*. Princeton, NJ: ETS.
- WorLD Professional Development Phases*. (2000). World Links for Development program (Program document).