Information Technology for Development 9 (2000) 105–121
IOS Press

Measuring long term effects of technology transfer in developing nations: the case of Internet training at the Romanian Academy of Science

Stephen R. Ruth
School of Public Policy, George Mason University, Fairfax, VA 22030, USA
Tel.: +1 703 993 1789; Fax: +1 703 993 2284; E-mail: ruth@gmu.edu

Abstract. Technology diffusion in developing nations is dependent on a continuous flow of good training for all users and potential users. Yet relatively little analysis of the results of this training has been done beyond cursory post-course evaluations. Despite the extensive investments in IT training by donors, multilateral organizations and the national governments, the return on investment for these courses and programs is not clear. This study aims to give a more explicit, long term perspective on IT training in developing nations by employing a popular evaluation model used widely in industry. The Kirkpatrick model treats the training event as only a first step in a process that ultimately involves changing attitudes, behaviors and even life styles. The Romanian Internet Academy case is a pilot study aimed at exploring longer term changes in attitudes and behaviors. While many predictor variables are appropriate, only age, gender, academic productivity and academic discipline were used in this preliminary study. Results indicate that this process can yield useful results for determining the true value of these courses and, just as important, can lead to establishing policies for improving results significantly.

1. Introduction

This paper introduces a realistic case study employing methodology that can be used to evaluate the long-term effects of Internet training in developing nations, with particular emphasis on the organizational, social and other external effects of Internet connectivity on the individual. Kirkpatrick's model of four levels of training evaluation, widely used by corporations, agencies and multilateral organizations like the World Bank, was found to be a suitable framework for structuring the study since it emphasizes the examination of longer term evaluations of changes in attitudes and behaviors instead of short term reactions to initial training. The focus of the study is researchers at the Romanian Academy of Sciences in Bucharest. Findings from the descriptive data indicate strong support for many aspects of Internet training, especially those related to the organizational milieu, and also show that there is a positive relationship between research productivity and Internet use. Lowest rankings were for Internet as a pedagogical aid, indicating that either the bandwidth or general training in Internet were still insufficient to be of much help in the classroom. The analysis of variance findings indicate significant differences among several sets of variables: gender, age, research productivity and academic discipline and suggest that some Internet training must take note of these differences, in order to be effective The application of this methodology to the Romanian researchers indicates potential for broader use. Since it meets the goals of many donors, bilateral and multilateral organizations in giving specific answers to questions

about the true long term value of Internet training, the approach can be used in other studies of transfer of Internet technology.

2. Why is Internet training in developing nations a significant issue?

This article addresses the evaluation of long-term results of Internet use in developing countries.[1] The topic is important for several reasons. First, in spite of the increasing attention to the so-called "digital divide", Internet implementation and training in developing nations is still relatively limited. A report of per-capita use of Internet by regions shows that North America and Western Europe/Scandinavia have, respectively, 492.6 and 220.5 Internet users per thousand population. For Asia-Pacific, South America, Eastern Europe and Middle East-Africa, the comparable figures are 20.7, 38.4, 37.2 and 8.2 [3]. A detailed assessment of Internet diffusion in developing nations [6] notes the paucity of Internet training infrastructure. If the aphorism that half the population of the world has never made or received a phone call is true, it is clear that a much larger proportion have no immediate prospects of learning to use the Internet. About 95 percent of the world's Internet hosts are in two dozen developed nations [US, Canada, Western Europe, Japan, Australia, etc.] which represent only 16 percent of the world's population [13]. China, one of the fastest-growing Internet populations, has about 2.5 million users, less than 0.2 percent of its population [1]. The slow pace of Internet implementation in developing countries makes it imperative that there be a high premium on taking full advantage of the most successful training modalities and for a careful evaluation process.

Second, there is little information on best practices and methodologies to accomplish Internet training in developing nations, where the unit costs of all data communication services are drastically higher than in developed nations. It would be unthinkable to dedicate a T1 line (1.53 million bits per second) to a few dozen users in a short Internet training course in Kenya, Peru or Bangladesh, when the unit costs for normal home or office bandwidth are prohibitive. In addition, the disparity in earning power increases the cost for normal Internet connectivity dramatically [19]. For example, in Kenya, the monthly cost for Internet connectivity (comparable to an America On line account in the United States) is about $US 100, roughly four times the monthly Gross Domestic Product per capita and five times the cost of a similar connection in Western Europe/Scandinavia [14]. To this financial impediment one must add the scarcity and uncertainty of bandwidth required to deliver good Internet training. The author, working on a training project in Kampala, Uganda, in 1999, found that the most stable connection possible for training a small group of public health students there was to set up a line-of-sight (wireless) connection from the Internet Service Provider to the client site. This fortunate confluence of circumstances (where the client site and the provider are within sight of one another) is, however, rare, and even with this advantage, the service is still subject to serious interruptions [11]. The entire city of Kampala has about five hundred thousand bits per second bandwidth capacity [12], a much higher amount than many large African cities, yet dramatically lower than cities like London and New York, where total bandwidth incoming and outgoing is measured in the hundreds of billions of bits per second. Third, measures of effectiveness for technology training in developing nations are frequently vague and unfocused. It is by no means clear which methods of Internet training provide the best results in terms that a donor can relate to: return on financial

[1] "Internet", as used here, refers to the telecommunications milieu that includes, email, World Wide Web, file transfer protocols, telnet, etc. "Developing" countries include Africa, Asia, Latin America and the Caribbean as well as transitional economies of Eastern Europe plus other nations on the European periphery like Turkey. See [8].

investment, long-term effects on improving the work force, reducing unemployment, and increasing regional stability. Frequently, for instance, mere possession of Internet technology tools (servers, modems, software, etc.) is incorrectly equated with successful utilization [20,21]. Simply owning these technology tools is an operational matter; gaining productive results from them is tactical and strategic. It is critical to have a stable and replicable methodology to assess which Internet training approaches work best in developing nations. This necessitates developing a criterion set – predictor variables and dependent variables that lead to determining cause and effect relationships concerning the milieu surrounding Internet training [18]. For instance, all things being equal, are men more positive about long-term effects of Internet training than women [9,15]? Are age or education predictors of more productive use of the Internet [2,9]? Are engineers more likely to leverage the Internet than historians [17]? Anecdotal evidence suggests that persons who work with numbers and machinery, like mathematicians and engineers, have an easier time using and gaining benefits from the Internet – but is this proven by actual results [4, 16]? Are there major regional differences – between Africa and Southeast Asia or South America, for example – that change the effect of the variables [5,17]? Does learning how to use the Internet change the lives of those trained [22]? Are they more competent, i.e., better able to do their jobs [16,21,23]? Do they have a different relationship within their organization [22]? Do they feel more connected with others in their country and beyond [7]? Understanding the long-term results of this diffusion process in the context of individuals and their world makes it easier to plan for better training as well as technology resource allocation.

This study addresses three problems: uncertainty about best practices, paucity of data on long-term effects of Internet training, and scarcity of information on predictor variables. Since Internet training can be the gate that opens a new technology, and in some situations a new life, in developing nations, this study offers a proposed methodology and rationale for more careful and detailed examinations of larger populations of users elsewhere in the world. The International Bank for Reconstruction and Development, a part of the World Bank, advises donor agencies that there are three reasons for doing assessments of this type: maintaining accountability for public funds, keeping the training cycle in touch with the client base, and providing lessons to guide future action [24]. The methodology of this study meets all these needs.

3. The study – an example of a replicable methodology

This study does not solve all the problems just described. It attempts to examine a replicable methodology that could be used in a developing nation to obtain realistic evaluation criteria for technology training, especially Internet-related. It offers an approach that could be used by donors or entrepreneurs to make more intelligent resource allocation decisions, especially in the context of large-scale Internet implementations in developing nations.

3.1. How are results of Internet training normally measured?

Internet training is usually considered a skills course – like learning the organization's accounting system or the word processing methodology. Yet, in a developing nation particularly, using the Internet is far more than just another technique to absorb in the work place. It can be a gateway to the rest of the world, a means of becoming linked to people, ideas, organizations and educational opportunities that were never possible before. Since Internet training is often managed as a one-time task by Internet Service Providers (ISP) in developing nations, assessment is normally accomplished only once, immediately after

the training. Evaluation criteria address methodology, instructors, teaching materials, learning spaces, etc. – not expected work impacts. This evaluation approach has several deficiencies. It captures skills attainment results only. It asks about expectations of Internet utility but does not seek later follow up information to measure long term outcomes. And it ignores the many variables that have been linked to successful implementation; e.g., long-term effects of work environment, bandwidth, interface, etc. [5].

3.2. Evaluation of longer term Impacts – the Kirkpatrick model

Many organizations world wide employ an assessment approach that goes far beyond the simple measurement of initial impressions of a training experience. They use a multi-phase model that begins with preparation for training and includes the learning experience itself, followed by periodic assessments of the training outcomes over a period of years. The focus on this model is the effect of the training over time on increasingly broad-based measurements of performance. If the individual is able to use the training in later experiences the results should be visible in productivity and other job-related metrics. At successive stages the individual is able to improve the performance of the unit, the organization and the customer – with results at least in part due to the effects of the training received. One of the most widely used examples of periodic impact analyses after a training experience was developed by Donald Kirkpatrick. It has been used for decades by the World Bank, IBM, Intel, Motorola, City of Los Angeles and many other organizations. This approach focuses on long-term effects, not simply immediate reactions. Kirkpatrick [10] categorizes four evaluation levels for institutional training programs:

1. Reaction – assessing immediate results and perceptions of the training environment. Reaction addresses a course participant's satisfaction with the learning experience. In terms of Internet training, particularly in developing nations, this evaluation level, if measured at all, is often the only indicator available.

2. Learning – determining the degree to which the learning experience has been responsible for changing attitudes, increasing knowledge, or improving skills. The emphasis on changing attitudes is important in this dimension, since many specialists feel that attitude modification is the only valid measure of a training experience [10, p. 20]. In Internet training situations in developing nations, the attitude change issue is significant. It can highlight the true value of a donor's investment by indicating that the result was not simply acquisition of a new skill but a positive modification of previously held attitude about the milieu surrounding that skill.

3. Behavior – this is often referred to as "transfer of training" and involves longer-term changes in job behavior attributable to the training experience. It is tempting to ignore 1 and 2 above and simply move to the objective measurement of on-the-job behaviors associated with training. But it is possible for conditions associated with reaction and learning (1 and 2 above) to be predictors for behavior modification. Transfer of training is crucial for Internet courses in developing nations since it is the manifestation of the learning and attitude change (if any) caused by the learning experience. While a donor could be satisfied with attitude change alone (learning) in an Internet course, it would be hoped that the result of the change in attitude could also be specific, measurable changes in the ability to use Internet to increase productivity at office, production site, or factory.

4. Results – Kirkpatrick describes this level as "the final results that occurred because the participants attended the program. . . increased production, improved quality, decreased costs, reduced frequency or severity of accidents, reduced turnover, higher profits, etc." [10, p. 23]. It is quite likely that an intensive series of Internet courses in a developing nation could even have institution-wide results, for instance, by reducing backlogs or improving communications speed and accuracy. However, the measurement problems are considerable.

There are several advantages that can be obtained through use of this four level evaluation methodology. First, it provides a more careful measurement of the return on investment for training, an important link between the budget and the organization's performance expectations. Second, it opens research opportunities into some of the demographics of training, specifically, the effects of age, gender, regional and cultural differences, equipment utilization, bandwidth, instructional methods, distance learning and the like. With longitudinal data covering a several year period after the training took place, it is possible to examine many variables that impact an individual's response to technology-based training. This research can lead directly to better planning management of the training. Third, the Kirkpatrick methodology is directly linked to the process of improving the training process. When the organization is committed to measuring impacts at each of the four levels, it becomes possible to determine training improvement opportunities at each phase of the evaluation process. While emphasis of this study is on the third of Kirkpatrick's levels, behaviors that occur long after the training has taken place, the methodology is fully capable of capturing any, or all, of the four measurements.

3.3. Study focus – the three day Internet course sponsored by Romanian Academy of Science

The base of this exploratory study is a rigorous three-day Internet training course offered since 1996 to researchers affiliated with the Romanian Academy of Sciences in Bucharest. The author established this course with funding from the Andrew W. Mellon Foundation, the Soros Foundations and Sun Microsystems, Inc. The aim of this program was to establish a long term Internet training capacity, staffed by local experts and supporting a major research effort in the country. The study population is a group of professors and lecturers affiliated with the Romanian Academy of Science. The Academy of Science, a large, multifaceted alliance of academics representing all fields of study, from drama to engineering, and centered in Bucharest, Romania's capital, has regional branches in Cluj, Timisoara and Iasi, and is organized into fourteen sections: Philology and Literature, Historical and Archaeological Sciences, Mathematical Sciences, Physical Sciences, Chemical Sciences, Biological Sciences, Economical Sciences, Engineering Sciences, Agricultural and Forestry Sciences, Medical Sciences, Economic and Law and Sociological Sciences, Philosophical and Psychological and Pedagogical Sciences, Arts and Architecture and Audio-Visual and Information Science and Technology (the newest section). In all, the Academy has sixty-six institutes and centers, with more than 2,600 researchers. The Internet courses are offered at facilities provided by the Academy and approximately eight hundred persons have completed the program.

The Internet courses began in 1996 with a class of twenty students and have continued at approximately two to three week intervals since then. The instruction consisted of rigorous program of concepts and practices of Internet use in an academic setting. Each course lasts three days, with eight hours of instruction per day. The first half of each day is an interactive presentation of the day's topic by a lecturer assisted by a supervisor. The students are guided through several lessons by their assigned advisor[2]. Student pairs share a PC with a high capacity Internet link provided by the Academy. The second part of the day is dedicated to individual exercises, the students again being assisted by lab helpers. The instructors (lecturers and supervisors) are researchers from the Academy's Computing Center, some with joint appointments with the University of Bucharest.

[2]Extensive notes are provided – for examples see http://www.racai.ro/manual.

Table 1
Samples of subjective satisfaction scores for Internet courses taught at the Romanian Academy for period September 1996–March 1997 (six course topics)

Marks:		Questions:				
1= unsatisfactory		Q1. Was the instructor well prepared for the course?				
3= adequate		Q2. Was the course material presented in an organized way?				
5= remarkable		Q3. Have you been intellectually stimulated during the lesson?				
Fundamental concepts		E-mail	FTP	Xarchie	Netscape	Harvest
Q1	4.58	4.69	4.61	4.67	4.71	4.68
Q2	4.42	4.52	4.26	4.42	4.44	4.40
Q3	4.15	4.17	4.08	4.23	4.20	4.18

Source: Dr. Dan Tufis, Romanian Academy of Sciences (tufis@valhalla.racai.ro).

4. Methodology – focus on long term outcomes

Every person completing the three days of instruction submitted an end-of-course evaluation aimed at determining satisfaction with the materials, instructors, content and other aspects of the learning experience. These results, shown in Table 1, are comparable to Kirkpatrick's Phase 1, Reaction, and show typical results. On a five-point scale, students were very positive about all aspects of the course. These reactions give a one-time view of the experience, useful in determining whether trainees were satisfied but devoid of any implementation or operational information. But satisfaction is an insufficient measure for results of a training experience. The emphasis of this study is assessment of longer term changes in attitudes and behaviors that could be attributed to the training.

4.1. Rationale for the questionnaire on longer term training outcomes – impact questions

For longer term assessments a more detailed questionnaire (given in Appendix) was developed, with the intent of determining results and the effects of Internet training on careers, research efficiency, outreach to colleagues and other factors. Its aim is to determine predictor (independent) and impact (dependent) variables that can assist in assessing the value of the Internet training. Fifteen impact variable questions were developed to evaluate five dimensions that could be affected by Internet training. First, it was expected that competence in the use of the World Wide Web and international email would increase the research competence of the Academy's members and staff. Two questions asked specifically about the effect of the training on research skills. Second, since Internet use can have some effects on the organizational milieu, three questions asked about the effects of Internet use in the context of relationships with management. Third, since most of those who completed the questionnaire were also involved in teaching at the university level, it was expected that the Internet would be perceived as a factor that would assist in teaching; three questions investigated this possibility. Fourth, the effect of Internet connectivity on extending relationships among colleagues was expected to be an important by-product of the training. Four questions explored this connection in the context of teamwork as well as linkages in and outside of Romania. Finally, four questions were personal inquiries – about whether the Internet had changed the individual's life in any way, improved earning power or had affected job performance.

In addition to fifteen specific questions concerning impacts, numerous profile inquiries were aimed at categorizing the respondents along routine dimensions such as gender, age, education, etc. and less

traditional classifications such as research productivity, academic discipline, time since training, computer skills, etc. The questionnaire was sent by email to 521 persons who had taken the training over the past three years, most of them separated by a year or more from their training experience. 207 of these researchers returned usable responses, a rate of 40 percent, quite high for a complicated questionnaire requiring thirty minutes to complete, especially considering their previous unfamiliarity with the Internet. Analysis of the non-respondents revealed them to have roughly the same demographic profile as respondents, so no further review was considered necessary.

4.2. Population characteristics

Tables 2 and 3 summarize the population by age, gender, academic discipline, and research productivity. The population is relatively young, more oriented to liberal arts than to engineering and predominantly female. These data closely reflect the aim of the training program – to be particularly sensitive to including women and liberal arts faculty, two groups often given less opportunity in programs of this type in developing nations. The numbers of female engineers and females in the various research productivity groups is proportionate to males, as it is in the Romanian Academy of Sciences generally. That

Table 2

Age distribution of respondents for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999

Reported age range	Frequency	Percent	Cumulative (%)
20–25	41	19.8	19.8
26–30	47	22.7	42.5
31–40	47	22.7	65.2
41–50	46	22.2	87.4
51–60	21	10.1	97.6
61+	5	2.4	100
Total	207	100	

Table 3

Research productivity of respondents by gender and academic discipline for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999

	Research productivity rankings			
	Low	Moderate	High	Total
Gender				
Male	33	25	13	71
Female	66	34	36	136
				207
Discipline group				
Engineering/Technical	17	17	11	45
Mathematics	12	2	8	22
Arts/Engineering/Law	70	40	30	140
				207

Note: Research productivity rankings are based on assessment (quantitative and qualitative) of reported activity in professional journals, conference proceedings, reports, etc. Mathematics group was merged with Engineering/Technical for data analysis.

is, although the courses are designed to accept more women than men, the ratio of women to men in the productivity statistics show no significant differences. The research productivity assessment was based on both quantity and quality of reported output. Three levels of productivity were used, based on the reported output of the sample group. Many of the respondents had few or no research publications, while others had significant academic output in Romanian and international journals.

5. Results – descriptive statistics and analysis of variance

Data analysis consisted of review of the descriptive statistics – means, ranges and measures of central tendency – followed by simple ANOVA treatment using four population clusters as predictor variables: academic discipline, gender, research productivity and age. The ANOVA dependent variables are responses to the fifteen impact questions described in 3.1 above. The impact questions were presented in a Likert scale with six allowable scores. Table 4 shows the fourteen key questions arrayed by average score on the 1–6 scale. Several insights can be gained from this summary data. The top half, those with scores of 4.49 to 5.02, indicate a very positive feeling for social issues associated with Internet proficiency. Four of the seven top positives have to do with individual comfort about Internet-mediated work place (no constraints from managers/colleagues, improved communication outside Romania, more open

Table 4

Response summary: fifteen impact questions for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999 with population grand means ($N = 207$)

Question	Topic	Mean (1–6 scale)
1. I feel no constraints from managers or colleagues on my use of Internet and WWW	Management	5.02
2. Internet and WWW have improved the way I am able to communicate with my colleagues outside Romania	Relationships	4.94
3. Internet and WWW have improved the opportunities to stay current with my academic discipline	Research	4.90
4. Internet and WWW have improved my ability to do the research required in my field	Research	4.70
5. Internet and WWW make it possible to do better on my job	Personal	4.62
6. My supervisors and superiors understand and encourage the use of Internet and WWW	Management	4.49
7. I am now more open to new ideas since I can communicate more freely on WWW	Relationships	4.49
8. Internet and WWW have made me more open to be willing to be open to the opinions of others	Relationships	4.22
9. The use of Internet and WWW have changed the way I approach my daily work	Personal	4.19
10. I am now better able to work on team projects where the same team members are connected to Internet or WWW	Relationships	4.07
11. My manager [or dean or chairman] actively supports the use of Internet and WWW	Management	4.05
12. Learning to use the Internet and WWW has improved my ability to earn a living	Personal	3.42
13. Internet and WWW have improved the way I am able to communicate with my colleagues in Romania	Relationships	2.98
14. Internet and WWW seem to be very helpful for my students too	Pedagogy	2.00
15. I regularly use Internet and WWW in helping my students	Pedagogy	1.39

to new ideas, and supervisors encourage). Three have to do with the job itself (do a better job, stay current with my discipline, and improve research ability). Among the negatives the two lowest scores 1.39 and 2.00 on a scale of 1–6, have to do with using the Internet to help students.

It would be tempting to draw preliminary conclusions from this aggregate data. For example, the preponderance of positive replies (over 4.0) might lead one to conclude that there is a generally positive attitude among Romanian researchers about Internet use. Or, the very low scores on the pedagogy questions could be interpreted as being an indication of low levels of training for college students since professors are not using the Internet in teaching. But alternative explanations are also possible. For example, in some universities, students tend to be more successful Internet users than faculty, so the low pedagogy ratings may simply reflect that the students are ahead of faculty, not that they are being shut out. As a general finding it does seem reasonable to conclude from the grand means shown in Table 4 that Internet training has a positive effect on managerial, personal, relationship, and research productivity variables.

5.1. Analysis of variance comparisons – Humanities/Arts and Engineering/Mathematics

Several interesting questions can be pursued based on the comparison of the fifteen impact question responses among the classification variables. Although over a dozen possible analysis of variance results could be described, four were selected, as an indication of the process used and to provide some tentative insights that could be examined in a more comprehensive study. Table 5 arrays the questions in terms of differences between the two broad categories of academic discipline: Humanities and Arts, and Engineering and Mathematics. These aggregations were used because of the sample size requirements and the relative homogeneity of the backgrounds in each group. Three significant differences appear. First, the Engineering/Mathematics group is significantly more positive about the use of Internet to communicate with colleagues. Second, the Engineering/Mathematics group is significantly more positive about using Internet for teamwork applications. Third, the Engineering/Mathematics group reports significantly more management support for using Internet in their work. These findings probably reflect the normal technology diffusion process in a university environment where “hard science” researchers often start using IT tools before other groups.

5.2. Analysis of variance comparisons – gender

Table 6 examines differences that can be attributed to gender – with two significant results. Women are significantly more willing than men to attribute Internet as being responsible for making them more open to new ideas and are also significantly less likely to use the World Wide Web in helping their students, although, as indicated in the aggregate data, both women and men use WWW relatively rarely in teaching students. There is no obvious explanation for this result beyond the fact that women outnumber men in this study and particularly so in the non-quantitative disciplines. For them, the more recent experience with Internet may have been particularly significant in opening a wider world of colleagues and idea-sharing. The more interesting interpretation, however, is that out of fourteen questions, only two showed significant gender-related differences.

5.3. Analysis of variance comparisons – research productivity

Analysis of variance for the research productivity data, in Table 7, shows a significant difference among the groups along three variables (only statistically significant relationships are shown). First, the

Table 5
Analysis of variance for responses to fifteen impact questions, by academic discipline (aggregated), for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999 ($N = 207$)

		N	Mean	SD	SE	F	Sig.
Internet changes work approach	Humanities/Art	139	4.09	2.74	0.232	0.687	0.408
	Engineering/Math	66	4.39	1.54	0.190		
Improves ability to earn a living	Humanities/Art	139	3.27	1.79	0.152	2.41	0.122
	Engineering/Math	67	3.70	1.68	0.206		
Better linkages outside Romania	Humanities/Art	139	4.73	1.50	0.127	7.67	0.006*
	Engineering/Math	67	5.34	1.30	0.159		
Better linkages in Romania	Humanities/Art	139	3.02	1.76	0.149	0.262	0.610
	Engineering/Math	66	2.89	1.72	0.210		
Supervisors and superiors encourage use	Humanities/Art	139	4.43	1.63	0.138	0.656	0.419
	Engineering/Math	67	4.62	1.58	0.193		
Stay current with academic discipline	Humanities/Art	139	4.86	1.25	0.106	0.497	0.481
	Engineering/Math	66	5.00	1.39	0.170		
Internet helpful for students	Humanities/Art	139	1.80	2.41	0.204	2.54	0.112
	Engineering/Math	67	2.40	2.72	0.332		
Internet Helps me to be better on my job	Humanities/Art	139	4.51	1.40	0.119	2.47	0.117
	Engineering/Math	66	4.85	1.45	0.178		
More open to new ideas due to Internet	Humanities/Art	139	4.37	1.52	0.129	1.74	0.189
	Engineering/Math	67	4.67	1.49	0.182		
More open now to other's opinions	Humanities/Art	139	4.24	1.48	0.126	0.052	0.821
	Engineering/Math	67	4.19	1.66	0.203		
Help students by using Internet	Humanities/Art	139	1.23	1.84	0.156	3.02	0.083
	Engineering/Math	67	1.74	2.27	0.276		
Work better now on team projects	Humanities/Art	139	3.76	1.68	0.142	14.7	0.000*
	Engineering/Math	66	4.73	1.71	0.210		
Manager (or dean) actively supports	Humanities/Art	139	3.82	1.91	0.162	6.20	0.014*
	Engineering/Math	67	4.52	1.80	0.220		
Improve research ability	Humanities/Art	139	4.38	1.61	0.136	1.92	0.167
	Engineering/Math	67	4.71	1.53	0.187		
Feel no constraints to Internet use	Humanities/Art	139	4.98	1.49	0.127	0.349	0.555
	Engineering/Math	65	5.11	1.57	0.192		

Note: ** significance 0.01 level or less; * significance at 0.05 level or less. Small changes in sample size for individual questions are due to incorrect or incomplete response.

most productive researchers show significantly higher scores for Internet use than the less productive group. Second, they indicate significantly higher use of Internet in teaching, probably because they have skills comparable or greater than their peers and students. Finally, the more productive researchers also indicate a significantly higher degree of management support for their work. These three findings are indicators of the expected benefits of Internet for researchers and especially for highly productive ones. It is not surprising that the most productive researchers are also the ones who are most likely to use the newest research capabilities of the Internet and WWW. What is surprising is that only three of the

Table 6
Analysis of variance for responses to fifteen impact questions, by gender, for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999

		N	Mean	SD	SE	*F*	Sig.
Internet changes work approach	Male	69	4.34	3.52	0.424	0.439	0.508
	Female	136	4.11	1.60	0.137		
Improves ability to earn a living	Male	70	3.44	1.75	0.210	0.008	0.927
	Female	136	3.41	1.77	0.152		
Better linkages outside Romania	Male	70	4.8	1.56	0.187	0.630	0.428
	Female	136	5.00	1.41	0.121		
Better linkages in Romania	Male	69	2.98	1.79	0.214	0.000	0.999
	Female	136	2.96	1.72	0.148		
Supervisors and superiors encourage use	Male	69	4.44	1.53	0.183	0.110	0.740
	Female	136	4.42	1.66	0.142		
Stay current with academic discipline	Male	70	4.97	1.17	0.140	0.253	0.616
	Female	136	4.87	1.36	0.116		
Internet helpful for students	Male	70	2.34	2.48	0.296	1.963	0.163
	Female	136	1.82	2.53	0.217		
Internet helps me to be better on my job	Male	69	4.48	1.47	0.175	1.026	0.312
	Female	136	4.69	1.40	0.120		
More open to new ideas due to Internet	Male	69	4.38	1.51	0.181	0.332	0.565
	Female	136	4.51	1.52	0.130		
More open now to other's opinions	Male	70	3.90	1.62	0.194	4.92	0.028*
	Female	136	4.40	1.47	0.127		
Help students by using Internet	Male	70	1.82	2.05	0.205	4.98	0.027*
	Female	136	1.17	1.94	0.167		
Work better now on team projects	Male	69	4.10	1.67	0.200	0.017	0.892
	Female	136	4.06	1.79	0.153		
Manager (or dean) actively supports	Male	69	3.92	1.84	0.220	0.456	0.500
	Female	136	4.11	1.93	0.165		
Improve research ability	Male	70	4.22	1.79	0.214	3.002	0.085
	Female	136	4.63	1.46	0.125		
Feel no constraints to Internet use	Male	70	4.75	1.62	0.194	3.434	0.065
	Female	136	5.16	1.44	0.124		

Note: * significance at 0.05 level or less. Small changes in sample size for individual questions are due to incorrect or incomplete response.

fourteen questions would result in findings that the high research productivity population was different from the less productive groups.

5.4. Analysis of variance comparisons – age

Table 8 describes the differences across age groups (only statistically significant results are shown). In general, the younger respondents were more positive in their responses than the older, but the only

Table 7

Analysis of variance for responses to fifteen impact questions, by research productivity ranking[1], for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999 – statistically significant results only

		N	Mean	SD	SE	*F*	Sig.
Internet helpful for students	Low	96	1.50	2.29	0.233	3.46	0.033*
	Moderate	57	2.50	2.71	0.360		
	High	45	2.37	2.59	0.387		
Help students by using Internet	Low	96	0.969	1.71	0.174	4.229	0.016*
	Moderate	57	1.75	2.10	0.279		
	High	45	1.80	2.22	0.331		
Manager (or dean) actively supports	Low	96	4.21	1.82	0.184	3.677	0.027*
	Moderate	57	4.26	1.77	0.235		
	High	45	4.37	2.05	0.307		

[1]Research productivity rankings are based on assessment [quantitative and qualitative] of reported activity in professional journals, conference proceedings, reports, etc.

Note: *significance at 0.05 level or less. Small changes in sample size for individual questions are due to inability to incorrect or incomplete response.

Table 8

Analysis of variance of responses to fifteen impact questions, by reported age, for survey of Internet courses taught at the Romanian Academy of Sciences 1996–1999 – statistically significant results only

		N	Mean	SD	SE	*F*	Sig.
Supervisors and superiors encourage use	Age 20–30	87	4.87	1.27	0.136	4.38	0.014*
	Age 31–50	93	4.25	1.72	0.178		
	Age over 50	25	4.07	2.01	0.395		
Manager (or dean) actively supports	Age 20–30	87	4.47	1.63	0.175	3.753	0.025*
	Age 31–50	93	3.76	1.96	0.204		
	Age over 50	25	3.69	2.25	0.430		

Note: *significance at 0.05 level or less. Small changes in sample size for individual questions are due to inability to incorrect or incomplete response.

significant differences were found with respect to supervisors' support and management support, where older employees were significantly less positive. There is relatively little information to predict the effect of reported age on technology interventions. In fact, in about half the responses, the oldest and youngest groups arrayed similarly in satisfaction order. Possibly this is because many younger researchers enter the automation milieu with the same initial tendencies of anxiety and fear that are often attributed to older workers.

6. Summary

The purpose of this short paper is to present initial findings about the long term effects of Internet training in the context of Romania's research community. However the methodology being relatively straightforward, it is capable of being used for other populations. Three of the findings in Romania appear to be generalizeable to other developing nations. First, the Internet is not yet perceived as a tool capable of being helpful in teaching students. It should be remembered that diffusion of Internet to the home is relatively rare in developing nations, and for that matter, even in some of the developed countries. Further-

more, when students use university-based centers in the developing world for Internet transmissions, the bandwidth is often painfully inadequate. Second, the general attitudes toward the technology milieu were positive – most of the grand means of question responses were well over 4.00. While there were some significant differences across gender, age, research productivity and academic discipline, the basic finding is that Internet use by the Romanian research community is generally viewed as an acceptable, career-enhancing activity. Third, the differences between the responses of men and women and of engineers and liberal arts professionals is a reminder that for Internet technology to have its most efficient diffusion, it will be crucial to set up structures (early training, anxiety reduction, etc.) for some groups beforehand.

6.1. Extending the methodology beyond the current project in Romania

The Internet presents a technology transfer challenge in the developing nations. The training and evaluation methodology used for the population of Romanian scientists should be considered as a viable option in almost any Internet project in developing nations for three reasons. First, since training is expensive and often of uneven quality, it is crucial to measure more than simple course satisfaction responses. Second, the true return on investment for the Internet training is not simply skills acquisition; more importantly, Internet should lead to a new kind of empowerment and productivity improvement, and measurements must examine this more subtle outcome. Third, and most important, a donor needs to know whether a training investment has a payoff in its intended purpose. The methodology used in this study is aimed specifically at responding to that need, in the context of changes in attitudes as well as behaviors.

6.2. Using the methodology to meet donor goals in other countries

Returning to the World Bank guidelines for donors mentioned earlier, the approach described in this study can be used to meet the three stated goals [24]. First, with respect to maintaining accountability, this methodology enables donors to monitor not simply the completion of a course [Kirkpatrick's "Reaction" phase], but to follow the impact from changes in attitude to changes in behavior and performance. The second goal, completing the training cycle and keeping in touch with the client base, is achieved routinely through the documentation provided in the data analysis. While not included in this report, extensive tracking data gathered on the Romanian researchers in this study could provide additional, more detailed course evaluation metrics. The third goal, providing a source of lessons to guide future action is also a result of the data bank assembled from the questionnaire. Comments on course elements that were and were not beneficial are contained in both the objective and subjective elements of the questionnaire.

The Romanian study offers a goal, a methodology, and a vision. The goal is making Internet training of the highest and most proven worth more available in developing nations. The methodology is one that examines long term effects of the training on significant dimensions of individual activity like work, career, status and productivity. The vision is one of parity – where eventually the benefits of Information Technology and its most potent instrument, the Internet, become available more equally to rich and poor, North and South. This lofty vision can only be achieved through careful and systematic introduction of the methodologies that have the highest payoff in financial and human terms.

Acknowledgement

A debt of gratitude is due to Dr. Dan Tufis, manager of the Internet Academy in Bucharest, who facilitated the data gathering, and Dr. Mihai Dragonescu, former president of the Academy, who encouraged

the idea of offering this training. Special thanks are also due to the Andrew W. Mellon Foundation, the Soros Foundations and Sun Microsystems, the sources of funding that made everything possible. Bryan Harter, Dr. Virgil Frizell and Imad Abi Saleh, of George Mason University, helped with several phases of the data analysis.

Appendix: Questionnaire (Translated from the Romanian)

Preliminaries:

1. Which course did you take (Beginner, Advanced)?
2. Date course taken (month/year)?

Part I

1. Age:
   1.1 20–25; 1.2. 26–30; 1.3. 31–40; 1.4. 41–50; 1.5. 51–60; 1.6 Over 60
2. Sex (M/F)
3. Highest degree (Indicate also the discipline)
4. Profession as you would describe it
5. Position
   5.1. Member of research project; 5.2. Project leader; 5.3. Consultant; 5.4. Other (specify)
6. Had you used a computer before the course?
   6.1. No; 6.2. Very little; 6.3. A lot;
7. How have you learned about the course?
   7.1. From a colleague; 7.2. From a friend; 7.3. From the secretary; 7.4. From the director; 7.5. By chance; 7.6. Other (specify. . .)
8. Why have you decided to attend the course?
   8.1. Required to attend (. . .); 8.2. Needed for my work(. . .); 8.3. Curiosity (. . .); 8.4. To be up to date with this novelty (. . .); 8.5. Other..(. . .)
9. What kind of Internet services have you used? (percentage of all usage):
   9.1. E-mail (. . .%);
   9.2. Browser WWW (Netscape) (. . .%);
   9.3. FTP (. . .%);
   9.4. Other (which?) (. . .%);
10. What was the purpose of using Internet?(mark from 1-low to 5-high)
    10.1. Communicating with other specialists
    10.2. Finding references
    10.3. Finding addresses of researchers or institutes
    10.4. Finding information related to your research
    10.5. Finding information about scientific conferences
    10.6. Finding other types of information (not directly related to your profession)
    10.7. Other (specify, if possible). . .
    10.8. No answer.
11. Nationality of used information:

11.1. Romania
11.2. USA
11.3. Canada
11.4. UK
11.5. Germany
11.6. France
11.7. Others. . .
11.8. No answer.

12. Do you think that by using the Internet you have less need of written media?

12.1. Yes, to a large extent
12.2. Yes, to a certain extent
12.3. Not really
12.4. Not at all

13. Indicate whether the course was enough to allow you to start using the Internet (choose one)

13.1. The length was appropriate
13.2. It was too long
13.3. It was too short

14. Indicate whether a follow up course would be necessary and you would be interested to attend

14.1. Necessary (I would definitely attend)
14.2. Useful (I would attend)
14.3. Somewhat useful (I may attend)
14.4. Not necessary (I would not attend)

15. Given the 3 day duration of the course, what Internet tools should be presented?
16. What do you think should be an ideal duration for the course, given the present content and students ability to attend?

Part II

For this part the questions have to do with your own personal feelings about the use of Internet and World Wide Web. Please select a number to answer each one according to the following scale

! 1 ! 2 ! 3 ! 4 ! 5 ! 6 !
Strongly disagree Strongly agree

1. The use of Internet and World Wide Web has changed the way I approach my work.
2. Internet and WWW have improved the way I am able to communicate with my academic colleagues in Romania.
3. Internet and WWW have improved the way I can communicate with my colleagues outside Romania.
4. Learning the use of Internet and WWW has improved my abilities to earn a living.
5. My supervisors and superiors understand and encourage the use of Internet and World Wide Web.
6. Internet and World Wide Web have improved the opportunities to stay current with my academic discipline.
7. Internet and WWW seem to be very helpful for my students too.
8. Internet and World Wide Web make it possible to do better on my job.

9. Internet and World Wide Web have improved my ability to do the research required in my field.
10. Internet and WWW have made me more willing to be open to the opinions of others.
11. I regularly use Internet and WWW in helping my students.
12. I am now better able to work on team projects where some team members are connected on the Internet or WWW.
13. My manager (or dean or chairman) actively supports the use of Internet and WWW.
14. I am now more open to new ideas since I can communicate more freely on the WWW.
15. I feel no constraints on my use of Internet or WWW from managers or colleagues.

Brief comments: In your own words would you please describe briefly
three of the most important advantages and three of the most important
disadvantages associated with your use of Internet and WWW.

Part III
1. Studies (highest degree)
Bacculaureate
BS/BA
MS/MA
PhD student
PhD
2. Type of current work activity
Research (project leader)
Research (project member)
Other
3. Indicate
Number of research projects you have worked on
Number of research reports you have authored/co-authored
Number of national scientific conferences you have attended
Number of international scientific conferences you have attended
Number of articles/reviews you have published in national journals/books/conference proceedings
Number of articles/reviews you have published in international ournals/books/conference proceedings
Do you belong to any national professional organization?
Do you belong to any international professional organization?

References

[1] 2000 China Network Information Center, *Statistics of China*, Internet http://www.cnnic.net.cn on January 20, 2000.
[2] C. Borgman, All users of information systems are not created equal: an exploration into individual differences, *Information Processing and Management* **25** (1989), 257–281.
[3] Computer Industry Almanac http://www.c-i-a.com/199908iu.htm on January 25, 2000.
[4] R. Gibson, Informatics diffusion in South American developing countries, *Journal of Global Information Management* **6**(2) (1998), 35–42.
[5] S. Goodman, L. Press, S. Ruth and A. Rutkowski, The global diffusion of Internet: patterns and problems, *Communications of the Association for Computing Machinery* **17**(8) (1994), 27–31.
[6] S. Goodman et al., *The Global Diffusion of Internet Project – An Initial, Inductive Study*, The Mosaic Group, Fairfax, Virginia, March 1998.
[7] R. Harris and R. Davison, Anxiety and involvement: cultural dimensions of attitudes toward computers in developing societies, *Journal of Global Information Management* **7**(1) (1999), 26–38.

[8] R. Heeks, Software strategies in developing countries, *Communications of the Association for Computing Machinery* **42**(6) (1999), 15–20.
[9] S. Hiltz and K. Johnson, User satisfaction with computer-mediated communication systems, *Management Science* **36**(6) (1990), 739–764.
[10] D. Kirkpatrick, *Evaluating Training Program*, 2nd edn, Berrett, Kohler, San Francisco, 1998.
[11] C. Musisi, Internet Service Provider in Kampala, and consultant to National Science Foundation's Network Startup Resource Center in email note to the author January 20, 2000.
[12] Network Startup Resource Center (NSRC) Uganda site (http://www.nsrc.org/db/lookup/ISO=UG).
[13] Network Wizards (www.nw.com), International Telecommunications Union Challenges to the Network, 1999, Internet for Development www.itu.int and Cyberatlas (Cyberatlas.Internet.com).
[14] B. Petrazzini and M. Kibati, The Internet in developing countries, *Communications of the Association for Computing Machinery* **42**(6) (1999), 31.
[15] R. Rice and D. Shook, Access to, usage of and outcomes for an electronic messaging system, *ACM Transactions on Office Information Systems* **6** (1988), 255–276.
[16] R. Rice and D. Case, Electronic message systems in the university: a description of use and utility, *Journal of Communication* **33**(1) (1983), 131–152.
[17] S. Ruth and R. Gouet, Must invisible colleges be invisible? An approach to examining large communities of network users, *Electronic Networking Research and Practice* **3**(1) (1993), 34–60.
[18] S. Ruth, Determining predictor variables for successful entry into electronic networking in developing nations, *Higher Education Policy* **6**(4) (1994), 39–42.
[19] S. Ruth, Implementing an Internet site in Africa: a cost assessment, *Africa Communications* (Summer 1996), 50–53.
[20] S. Ruth, Let's get real about technology-based learning: the medium is *not* the message, *Educom Bulletin* **32**(5) (1997), 32–41.
[21] L. Safeyeni, An empirical investigation of two electronic mail systems, *Behaviour and Information Technology* **7** (1988), 361–372.
[22] L. Sproull and S. Kiesler, Reducing social context cues: electronic mail in organizational communications, *Management Science* **32** (1990), 1492–1512.
[23] L Sproull and S. Kiesler, Computers, networks and work, *Scientific American* **265** (1991), 116–123.
[24] S. Taschereau, *Evaluating the Impact of Training and Institutional Development Programs*, ICRD/The World Bank, 1998, p. 3.