The Role of Community Colleges in Expanding the Supply of Information Technology Workers

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May 2000

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This report was prepared at the Urban Institute for the U.S. Department of Labor, Office of the Assistant Secretary for Policy, under DOL Contract No. J-9-M-5-0048. The views expressed are those of the authors and should not be attributed to the Department of Labor, the Urban Institute, or their sponsors. The authors would like to thank all of the interviewees for their participation in this study. We extend special thanks to Marcia Williams, Colleen Owings, Dennis Kirlin, Bill McDaniel, Nancy McNamara, and Neil Evans for their cooperation and for giving us access to data on community colleges.

Abstract

This paper examines the role of community colleges in expanding the supply of information technology (IT) workers. Drawing on both quantitative and qualitative methods, we find contrasting evidence on the importance of these institutions. Analysis of the 1994 and 1999 Current Population Survey and interviews with large IT employers indicate that community colleges are not adding significantly to the supply of IT workers. However, enrollment data and case studies of four community colleges suggest that students undertake a substantial amount of IT training at community colleges. While graduation rates are low, enrollment in community college IT programs is high. Moreover, there is evidence that community colleges contribute to retraining workers who are already in IT jobs, those switching to IT careers in mid-life, and those with previous bachelor's degrees.

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I. Introduction

The demand for information technology (IT) workers[1] has increased rapidly over the last decade and is projected to rise much faster than employment as a whole. The expansion of jobs for computer scientists, database administrators, network administrators, web specialists, and systems analysts appears to have exceeded the growth in the supply of U.S. citizens who are trained IT workers. Industry representatives contend that the U.S. faces a shortage of hundreds of thousands of IT workers, a shortage that justifies enlarging, for a second time, the H1-B program that grants 115,000 temporary visas per year.

Meanwhile, students have responded to the new opportunities in IT, but colleges and universities are having trouble keeping up with the increased demand for courses in computer science, computer engineering, and other information technology fields. While employers have clearly demonstrated their willingness to hire bachelor's degree (BA) graduates in computer-related fields for IT occupations, the future of community college associate's degree (AA) graduates in IT is less clear. Community colleges would seem to be a natural supplier of low- and intermediate-skilled workers. However, some employers are concerned that two-year colleges cannot provide the in-depth training necessary for high-tech jobs. Recent reports suggest that public and private employers are not interested in hiring trained community college graduates for available IT openings (Behr, 1999; Virginia Governor's Commission on Information Technology, 1999). At

[1] For the purposes of this paper we adopt the National Academy of Sciences' definition of IT workers, unless otherwise noted. The definition follows: Information technology workers are those persons engaged in the conception, design, development, adaptation, implementation, training, support, and management of computer-based information systems at the professional, paraprofessional, and technician level.

the same time, thousands of students are taking computer-related courses at community colleges.

What, then, is the role of community colleges in expanding the supply of information technology workers? Are community colleges responding effectively to the dramatic jump in demand for IT workers by offering solid education and training to a large number of students? Or are community colleges doing little to expand the supply of IT workers? This paper investigates the issue using quantitative and qualitative methods. In particular, we asked how many IT jobs are being filled by community college graduates? How do community colleges prepare students for careers in IT? How do employers view community college graduates? And how do employers and community colleges interact with respect to internships, curriculum development, and job placement?

The evidence yields contrasting stories concerning the importance of community colleges. Quantitative analyses of AA graduates and interviews with large IT employers indicate that community colleges do not make a significant contribution to the supply of IT workers. However, data on enrollments and case studies suggest that community colleges undertake a substantial amount of IT training. While graduation rates are low, enrollments in community college IT programs are high. Moreover, there is evidence that community colleges contribute to retraining workers who are already in IT jobs, those switching into IT careers in midlife, and those with previous bachelor's degrees. We identify a few model community college programs as well as promising advances in IT training in all of our focal colleges. If these successful practices and programs can be more widely diffused across the country, community colleges may in fact be able to make a significant contribution to the supply of IT workers in the economy.

The next section presents tabulations from the 1994 and 1999 Current Population Surveys (CPS) on the number of community college graduates in IT positions. Section three describes findings from case studies of four community colleges. And section four reports on evidence drawn from interviews with IT employers in the vicinity of the focal colleges.

II. An Analysis of National Patterns

Most Americans harbor an image of the typical IT worker as young, highly-skilled, and (with the possible exception of Bill Gates) highly-educated. And it's no wonder. The news media constantly reminds that that there are recent college graduates making upwards of $50,000 their first year out of school—and others who will be millionaires before they turn 25. But are these images a reality? To what extent do employers use highly-skilled and highly-educated workers? Did employers relax education and skill requirements to achieve the remarkable IT employment growth that has characterized the last few years? Are IT employment patterns the same for older and younger workers? How did the rising share of students going to college affect IT employment? Were the less-educated and older workers left behind in this expansion? And how did community college students fare in the expansion? These are complex questions, especially given the limits of national data and the intricacies of the IT labor market.

It is especially difficult to determine how many people receive training at a community college and exactly who these people are. Unlike students at four-year colleges, we cannot assume that community college students have a high school diploma,

nor can we assume that they are enrolled in a degree program. But we can fit most of these students into four basic categories: new career students just out of high school, re-career students switching careers in midlife, "upskillers" who are already in IT occupations but need to upgrade their skills, and liberal arts degree holders who are going back for interest or to add a technological component to their current job (Northwest Center for Emerging Technologies [NWCET], 1999). But further details on who these students are and on numbers of students in each category are hard to find. Issues also arise when trying to determine what subjects students major in and what types of companies they work for after graduation. But despite the limitations, the data and case studies analyzed below do in fact provide some of the answers we are looking for.

We analyzed six months of data (January through June) from the 1994 and 1999 Current Population Surveys to determine the share of IT workers with associate's (AA), bachelor's (BA), and graduate degrees; the share of each educational group going into IT careers; and the role that each educational group played in the growth of the IT workforce over the last five years. We limited our tabulations to three categories of IT workers defined by the Bureau of Labor Statistics three-digit occupation codes 64, 65, and 229—computer systems analysts and scientists, operations and systems researchers and analysts, and computer programmers, respectively.

Which Education Groups Are Filling IT Jobs?

Between 1994 and 1999, the CPS data indicate that overall employment rose 8.75 percent for the general population, while IT employment rose almost four times that amount, or 34 percent. Who were these new workers? Of the 700,000 new IT workers in this period, 72 percent held a BA or higher, and only 3 percent held an AA as their

highest degree (Figure 1). Thus, despite the shortage of IT workers, employers were able to fill openings with highly-educated workers.

The absolute number of IT workers with an AA degree increased over this five-year period from 1994 to 1999 (Table 1) but, more interestingly, the proportion of IT workers with an AA decreased over the last five years—from 10.91 to 8.74 percent. Among the younger workers, ages 25 to 34, the decline was more extreme. The proportion with an AA dropped almost five percentage points in the same time period (Table 2). Another interesting indicator is the share of AA and BA graduates entering IT careers. The CPS reveals that the proportion of AA graduates entering IT careers remained constant at a time when graduates with bachelor's or higher degrees were increasingly likely to go into IT occupations (Figures 4 and 5).

Bachelor's degree holders made the largest contribution to IT employment growth. This group accounted for over half of all IT employment growth and over 40 percent of IT employment growth among young workers. But graduate degree holders experienced the largest proportional increase among all IT workers. The effect was especially strong for younger workers. The proportion of young IT workers (25 to 34 year-olds) with graduate degrees increased from 14.67 to 19.32 percent. In fact, those with graduate degrees have become the education group with the highest proportion of IT workers—6.48 percent (Figure 5). These data describe a market that overwhelmingly prefers four-year and graduate degree holders. Moreover, there is no evidence that employers had to lower their education requirements in the past five years to attract workers. If anything, they are upgrading their workforce by hiring workers with more education than their existing employees.

Adding the "some college" group to complicates our assessment. Between 1994 and 1999, the proportion of IT workers with some college remained constant for IT workers in general (around 16 percent) but increased for the younger cohort—from 11.18 percent to 15.01 percent over the past five years. And this group accounted for 17 percent of IT employment growth. But details on the some college group are elusive because the data do not permit us to distinguish students who attended some college at a four-year college (e.g., Bill Gates) from those who took a few courses at a community college or even a proprietary institution.

The Education Growth Effect vs. The IT Growth Effect

The findings in the previous section lead us to ask further questions about the nature of the educational composition of IT job growth. The most natural question to ask is: why did BAs and graduate degree holders experience higher market penetration than AAs? How much of the change in IT employment was due to increases in the number of people earning college and graduate degrees and how much was strictly a consequence of the growing popularity of IT professions? To answer this question, we decomposed the growth of IT employment into the *IT growth effect* and the *education growth effect*, as defined by the following equation:

$$IT_2 - IT_1 = \sum_{j=1}^{n} ED_2^j it_2^j - \sum_{j=1}^{n} ED_1^j it_1^j$$

$$= \sum_{j=1}^{n} \left(ED_2^j - ED_1^j\right) it_1^j + \sum_{j=1}^{n} ED_1^j \left(it_2^j - it_1^j\right) + \sum_{j=1}^{n} \left(ED_2^j - ED_1^j\right)\left(it_2^j - it_1^j\right)$$

Where IT_i = Total number of IT workers in period *i*.

ED_i^j = Total number in education category j in period *i*.

it_i^j = Percent of education category j who are employed as IT workers in period *i*.

The *IT growth effect* measures the changing penetration of educational groups in IT occupations; it captures the degree to which college graduates were more likely to take IT positions in 1999 than in 1994. The *education growth effect* shows the impact of changes in each education category on IT employment, assuming no change in the tendency for members of the educational group to enter IT jobs. The decompositions appear in Tables 3 and 4.

In the case of the associate's degree category, the IT growth effect is triple the education growth effect for the younger group of AAs. We can therefore infer that the decrease in the employment growth of AAs for younger workers is mostly due to a decrease in the proportion of AAs going into IT rather than a decrease in the proportion of the general population pursuing AAs in all fields. AAs are contributing to the growth in IT less than they are contributing to the growth in the overall labor force. AAs today are not penetrating the IT market as well as they did in 1994. While young IT workers with AAs had approximately 50 percent of the penetration of BAs in the IT market in 1994, they were down to 38 percent relative to BAs in 1999.

The IT growth effect and education growth effect each accounted for approximately 50 percent of the total growth for BAs. Thus, the increased number of students pursuing four-year degrees and the increased interest in IT exerted roughly equal forces on the IT employment growth of this group.

For graduate degree holders, the IT growth effect was nearly four times stronger than the education growth effect. The data show that employers are able to attract an increased share of those with graduate degrees into IT positions.

As for the some college group, the decomposition indicates that these individuals were more likely to go into IT careers in 1999 than they were in 1994. Like the graduate degree holders, the IT growth effect was particularly strong for the some college group—triple the education growth effect among all IT workers and almost five times the education growth effect among the younger cohort. It is therefore not the growth in the some college group but growth in the proportion of the group going into IT that is accountable for this group's growth in IT employment.

The problem is, how do we interpret the results for the some college group? Do the rising numbers indicate that community colleges are effective in expanding the supply of IT workers? Unfortunately, our ability to analyze this educational category is necessarily limited because of the nature of the data. As mentioned above, we cannot distinguish those students who attended "some college" at a community college from those who attended "some college" at a four-year institution. If students in this educational group are turning to community colleges for their training, then the poor labor market outcomes for the AA group may be at least partially offset by the performance of the "some college" group. In addition, the BA group may include a

substantial number of students taking advantage of community college IT programs to upgrade or switch careers, but we have no way to measure how many of these students there might be. The next section explores this topic in more depth. But in light of these complications, our conclusion that community colleges are not making a substantial contribution to the supply of IT workers may be premature and merits further examination.

Major Field of Study

Another problematic issue is the lack of CPS data on college enrollments and major field of study. It is possible that many IT workers did not in fact get their IT training from the institution that is listed as their highest degree completed. How many AAs received their IT training at the community college and how many majored in other subjects? How many BAs obtained computer science degrees at their four-year college and how many took advantage of IT programs at other institutions?

While CPS data does not provide answers to these questions, data collected by the Department of Education sheds some light on the topic. According to the Digest of Education Statistics, 275,000 students majored in computer science at two-year or less-than-two-year institutions in 1995-1996 (Department of Education, 1999). If each of these students took two years to graduate, we would observe about 135,000 AA graduates in IT fields per year. This figure is 13.5 times the number of actual graduates reported in the Digest of Education Statistics and 29 times the annual IT employment growth for AAs as indicated by the CPS. These discrepancies suggest that students are enrolling in community college IT programs but not graduating with an AA. Add to this the fact that two-thirds of two-year computer science students are over age 25, compared to an

average of just 52 percent over age 25 in all majors in two-year institutions, and we have some evidence of the retraining role of community colleges when it comes to IT. Presumably, older students with a BA or experience in other fields are using community college computer science programs to further their technical training but find no need to stay to complete the AA degree. It is important to note, however, that many questions are still unanswered. We do not know how many computer science majors actually go into IT occupations. Nor do we know the percentage of two-year students who already have four-year degrees and vice versa. With a dearth of data on the subject we turn to case studies for a closer look.

III. The Community College Perspective

Site visits to community colleges can provide us with individual details on IT programs, curricula, student population, and job placement that national-level survey data lacks. Often these colleges collect their own data on the past employment and education of their students, jobs and earnings after leaving the college, reasons for leaving, and graduation rates. Though specific to the individual college, these data and the perspectives of those involved can help us answer some of the questions that we could not answer above, such as, Who are community college students? How many students have BAs already? How many are just out of high school? Case studies also allow for institution-level comparisons. We can evaluate the programs, curricula, career resources, organization, goals, faculty, and other such institutional details—picking out best practices and problem areas. And by strategically choosing certain colleges for our pilot

study we can begin to see if connections with employers make a difference in the quality of IT training and job placement at community colleges.

Methodology

The case study portion of our project focused on four community colleges and selected high-tech firms in the same metropolitan areas. We deliberately chose two colleges with formal links to local employers. Bellevue Community College was one such college, boasting a program in conjunction with a nearby giant of the IT industry—Microsoft. Iowa Western Community College, in Council Bluffs, Iowa, was the second college with formal links to employers that we used in our case study—a college participating in the IBM University Partnership. The other two colleges were chosen randomly because they happened to be located near employers we spoke with, but they had no formal links to those or any other employers. These colleges were Northern Virginia Community College in Alexandria, Virginia, and American River College in Sacramento, California. At all four colleges, we conducted interviews with deans, IT program chairs, IT instructors, and career counselors to better understand the programs and practices of each college.

One last component of the case study was an interview with the executive director of the Northwest Center for Emerging Technologies (NWCET) in Bellevue, Washington. This nonprofit organization was created to build partnerships between business, education, and government to create solutions for IT education. Among its most noteworthy contributions to the field of IT training and education is a set of IT skill standards for eight different IT career paths.

Enrollments in the Focal Colleges

How many students are enrolled in IT programs in the average community college? It is difficult to tell. Methods of data collection vary across the focal colleges. In fact, each focal college has its own measure of IT enrollment. Some colleges include only those students enrolled in a degree program, while others calculate the number of students taking any IT class. And definitions of IT classes and programs also vary a bit from one college to another.

Given these differences, the colleges' IT enrollments range from 400 to 7,000 students and comprise between 7 and 24 percent of the total enrollment in each of the colleges, as shown in Table 5. These enrollments seem high—though not inconsistent with the Department of Education's estimate of computer science majors in two-year colleges. It is important to note, however, that since our focal colleges are all located in high-tech areas, the number and percentage of IT students in these colleges may be higher than in other parts of the country.

Perhaps the most interesting finding from the colleges' data is that most community college IT students are not interested in receiving a degree or certificate. The two colleges that provide information on the number of IT students planning to get a degree or certificate as compared to the total number of IT students reveal striking results. At Bellevue Community College, over a period of three years, only 13 percent of enrolled IT students graduated with an associate's degree, compared to 83 percent who left before completing even the shortest certificate program. In fact, almost one-third of all IT program participants between 1994 and 1997 left before completing even 10 class credits. In interviews at American River College, several administrators agreed that 99

percent of IT students leave American River College without even obtaining a certificate. While many students are not interested in obtaining a degree or certificate, others—though they may have taken all of the required courses—do not bother to fill out the form and pay the $2 fee for the certificate, possibly because they are afraid of losing their financial aid. This evidence on low graduation rates reconciles, at least to some extent, the high enrollments found in the Digest of Education Statistics with the low number of IT workers holding an AA as their highest degree. Moreover, it supports the contention that the some college group indicated in the CPS may include a disproportionately large share of community college IT students—most likely a large portion of the upskillers and re-career students.

The proportion of students with a bachelor's degree in the focal colleges is also quite significant. Fourteen percent of American River IT students and 24 percent of Bellevue IT students hold four-year degrees. These relatively high proportions of liberal arts degree holders indicate that more people are taking advantage of community college IT programs than can be expressed in the CPS data. Some colleges are even starting new programs to target this pool of students more directly. Northern Virginia Community College, for example, has developed a special Technology Retraining Internship Program to cater to non-technical bachelor's degree holders. After just six months of intense classes and internships, these students are deemed ready to enter a whole new career in IT—albeit in an entry-level position.

The age distribution of students at the focal colleges also lends support to the retraining hypothesis. At Bellevue Community College, the average age of students in the IT program was 35 in the fall of 1998, compared to an average age of 25 for all

Bellevue for-credit students. Almost one-third or 32 percent of IT students were over age 40, compared to only 13 percent in all credit programs combined. The proportion of IT students over age 40 at American River College was 28 percent, only slightly lower than at Bellevue. Our focal colleges appear to be key contributors to lifelong learning.

IT Programs and Curricula

Most community colleges offer an assortment of two-year associate degrees in IT—usually in the department of information systems technology in the areas of programming, networking, database administration, and technical support. Certificate programs usually take one year or less to complete and are more product specific, often ending in a standardized test developed by the vendor. The Microsoft Certified Systems Engineering certificate is popular, as are A+, Oracle, Cisco, and Cobal certificates.

A typical curriculum for an IT associate's degree might be the information systems technology program at Northern Virginia Community College (NVCC). This two-year program is made up of a one-year core of introductory and general education classes and one year of specialization in an area such as application development, microcomputer support, networking, or career studies. First-year requirements include two writing classes, two business classes, two computer programming classes, a math class, and three introductory courses: introduction to information systems, introduction to microcomputer software, and introduction to telecommunications. During the second year, students pursue their concentration. For the application development specialization, for example, they are required to take classes on microcomputer operation systems, architecture, and hardware; computer information systems development; database management; and speech communication, in addition to two programming electives. The

networking specialization is almost the same, except that networking electives replace the programming electives and a class on local area networks replaces database management. Upon completion of these two specializations, students can expect to find work as programmers or network specialists, respectively. Students may also take advantage of NVCC's formal articulation agreements for transfer into computer and business-related bachelor's degree programs at several local four-year colleges.

Skill Requirements

How well do community college IT programs prepare students for employment? Do they teach the skills that employers demand? Our case studies did not reveal any serious incongruities between the technical skills offered by community colleges and those demanded by employers. For the most part, the colleges offered the technical skills that employers wanted for their low- and intermediate-skilled positions. In fact, they were often the same skills that the employers required for higher-level positions.

But beyond the technical elements, every employer we spoke stressed the need for employees and recruits to have good "soft skills." Several employers we spoke with cited teamwork, communication, and problem-solving skills as the most difficult attributes to find when recruiting new employees. In response, most community colleges have increased the number of group projects in technical classes and added writing requirements to IT majors, as evidenced in the example above. The employers we spoke with also mentioned that language skills were lacking among many foreign-born workers, often limiting these workers' career prospects. Frustrated with traditional English as a Second Language classes, Bellevue Community College offers accent-reduction classes

for those students who have a command of English grammar but need extra assistance with pronunciation.

Curriculum Development

How and where do colleges get information on what employers want? And how do they go about incorporating these suggestions into their curricula? The processes differ across colleges, but most have an advisory board of approximately 10 to 20 local industry representatives who give suggestions as to what the college should offer. Then changes to the curriculum must be approved by a committee that may convene anywhere from once a month to once a year. The frequency of these meetings plays a key role in the college's ability to adapt to technological change. At Iowa Western, curriculum changes take only 30 or 40 days. In contrast, at American River College the process may take a year or more since the curriculum committee meets annually. However, the college gets around the lag by offering the new classes on a temporary basis until they can be approved. Bellevue Community College has a particularly flexible curriculum, as administrators purposely do not specify the type of software or technology to be used for a specific class. The instructor can therefore update software or use a different operating system without going through the curriculum process. American River College does not have this luxury. Since a California law prohibits students from taking a class more than four times, if the college wishes to update the software or programming language it uses for a particular class, it must offer a new class to allow students who took earlier versions to participate. For example, the same "Introduction to Computer Programming" class might have been originally taught in Fortran a few decades ago, then upgraded to BASIC, then to Cobol, C, C++, and now to Visual Basic. An individual at a California community

college wanting to keep up with the latest programming languages over the course of several years would not be able to repeat this "Introduction to Computer Programming" class more than four times. Thus, American River College has to go through the whole year-long curriculum process to create a new class for each programming language to ensure that everyone can participate.

Despite the wide variety in the speed of curriculum processes, the NWCET claims that flexibility in curriculum is one of the reasons why community colleges are better suited than four-year colleges to train IT workers. Two-year colleges can react to industry demands more quickly and are not burdened by the bureaucratic structure of four-year colleges and universities. Moreover, the focus on more practical applications as opposed to theoretical issues means that community colleges are better adapted to speed the technology innovation cycle. The quicker a new system or application can be taught, the quicker its deployment in industry, and the quicker new innovations will be developed.

Faculty

Perhaps the most critical problem that community college IT programs face is the lack of faculty. Every program director we interviewed spoke at length about this topic without any prompting. Given their financial restrictions and union contracts, it is simply impossible for community colleges to compete with the salaries offered by private businesses. Even relaxing the requirement for candidates with master's degrees has not helped these colleges recruit instructors. At NVCC, the program director of the information systems technology program estimates that his program needs 19 full-time instructors in addition to the 11 current full-time faculty members to keep up with the

demand for IT classes. Moreover, just one week before classes started in spring 2000, there were still 12 vacancies for adjunct instructors and 60 instructors who were already committed. Several classes were in danger of being cancelled.

Links with Employers

Two of our four focal colleges have formal links with employers. Bellevue Community College is one of five "mentor" colleges in the Working Connections Program. The program was launched in 1997 when Microsoft pledged $7 million in grants over five years to be used for the development of IT programs in community colleges. Five mentor colleges were designated to provide guidance and support for to the 23 other "mentee" colleges in the program. The mentor colleges, including Bellevue, receive grants of $100,000, and the mentee colleges receive between $200,000 and $300,000 each to be used to train IT faculty, purchase equipment, and recruit and support disadvantaged students interested in IT careers. In addition, all participating colleges receive free Microsoft instructional software and licensing. So far, the program seems to be a success. The support the colleges receive has helped start numerous pilot programs across the country.

Iowa Western Community College participates in the IBM S/390 University Program, which encourages colleges to teach mainframe hardware and software. IBM links colleges (four-year and two-year) with a particular industry customer that uses a 390 system. This partnership provides the customer access to a pool of qualified S/390 workers, while colleges benefit from a comprehensive curriculum developed by IBM, faculty training on the latest S/390 facilities, and a new Business Residency internship program for students. Currently, one community college and two four-year colleges

serve as model programs, and 17 others, including Iowa Western Community College, are considered member institutions. This type of firm-specific program has the benefit of giving students immediate access to a specific employer and the skills needed to get a job there. But what students gain in access to employers, they may lose in skill transferability. Firm-specific programs, with their tailored curricula, may not give students a broad enough base to switch career paths or employers later in life. These types of programs then cater to a certain type of student—perhaps "upskillers" who already have a base of IT experience but want a new skill set, or re-career students who are hoping to permanently switch careers.

Iowa Western also collaborates with the Applied Information Management Institute (AIM) in Omaha, Nebraska, to improve its IT program. AIM is a consortium of local businesses, colleges and universities, secondary schools, and state government created to support and promote business and community growth related to IT. It helps define job skill requirements, design curricula, and provide applied work experiences for IT students.

The two other community colleges we visited did not participate in these types of programs. However, both were actively strengthening their own IT programs. American River College and the Los Rios Community College District (which includes two other colleges) initiated their own program, called Tech Force 2000, with the goal of graduating 1,000 students in computer information systems and electronics by the year 2000. As part of this effort, the college created a high-tech task force to improve and market the colleges' IT training programs and to work more closely with industry to better meet their needs. The results have been promising.

Career Resources

Community college students tend to have limited career resources at their disposal. Only one of our focal colleges—Iowa Western—had a structured career center and a mandatory class on job search strategies. This college also boasted a 100 percent placement rate for its IT students at graduation last year. The other colleges all had career centers, but most offered only an occasional career fair or simply posted job listings off the web. At these three colleges, most students found jobs on their own, or occasionally through informal connections with their professors. But even at Bellevue, teachers did not want to spend the time counseling or seeking out potential job opportunities for their students. One IT instructor mentioned that it was difficult even to get instructors to fill out a form and place it in a binder when they knew of an opening in the IT field. These less-than-spectacular resources may simply be a factor of the size of the colleges. Iowa Western was by far the smallest of the focal colleges and a career center on a campus of this size can easily accommodate the number of students on campus. The other colleges, however, might just have too many students for any type of active career counseling system. In addition, with budget cuts, career centers are often the first to go. Northern Virginia, for example, used to have a co-op office where counselors would find students paid internships in industry. But with budget cuts, the co-ops ended. There is talk of restarting some type of internship program, but faculty are unwilling to give their time without compensation. Iowa Western, on the other hand, has very close ties to industry. At this college, students in the programming major are required to complete a project that can be based on a case study or work-based within a company. The students must find their own projects, but many are choosing to do them

for local Omaha businesses. There is also a formal internship program at several local businesses, including banks and insurance companies.

But despite these shortcomings, faculty at all of the colleges contend that their IT students are not having any problems finding work. Those who graduate with an associate's degree can expect to find positions in technical support, web design, network support, microcomputer programming, and database administration. While none of our focal colleges track their graduates, Bellevue was able to compile a few statistics on employment rates and salaries of their students. The employment rate among all IT program participants, including those who left before earning a degree or certificate, was 84.7 percent between 1994 and 1997. The rate among those students who received a degree or certificate in IT was only slightly higher, at 88.6 percent. In all IT majors combined, 1997 graduates earned on average $29,000 annually—approximately $3,000 more than program leavers that year. In the programming major, the mean salary of graduates between 1994 and 1997 was almost exactly the same as the mean salary of program leavers. And in the tech support program, leavers actually fared better than graduates between 1994 and 1997, making on average $1,700 more per year. These employment outcomes suggest that an associate's degree may not be as highly valued as the actual skills themselves. For many students, especially upskillers, re-career students, and liberal arts degree holders, the AA degree is simply not worth getting if they have just as good of a chance at finding work and earning a good salary without it. They can supplement their previous experience with just a few classes on specific skills and not waste their time on the writing, speech, and business requirements that the associate's degree requires. The AA program seems to fit recent high school graduates best—

especially because they are able to transfer to a four-year college after they complete the degree.

Who hires the students who do not go on to a four-year college? Faculty and career counselors indicate that students are mostly finding work in small and medium-sized firms, often through temp agencies and in start-ups. They remark that the large IT firms are not very interested in hiring community college graduates because they have the money and resources to recruit at four-year colleges. According to career counselors and deans of community colleges, these large firms take only four-year graduates simply because "they can." We explore this topic from the point of view of employers in the next section.

IV. The Employer Perspective

Methodology

Employer interviews were another component of the case studies. Our goal was to describe the impressions that employers have of community college programs and graduates, as well as to assess their demand for different types and levels of IT workers. To accomplish this goal, we spoke to three large high-tech employers located in the vicinity of our focal community colleges. At these firms we conducted interviews with vice presidents of human resources, hiring managers, recruiters, and project managers.

What Do Employers Think About Community College Graduates?

Hiring managers at the large IT firms confirmed the contentions of the college faculty, admitting that their firms never recruit community college graduates. Their reasons varied. Some claimed that students who were serious enough about a career in IT

would go on to a four-year college, especially given the numerous financial aid options available today. To them, an associate's degree signaled a lack of motivation. Other hiring managers argued that the theoretical foundations and critical thinking skills required to obtain a bachelor's degree in computer science are necessary to succeed in the field. Despite these negative perceptions, all of the managers we spoke with agreed that they would certainly hire a community college graduate who had years of experience and proven expertise. If a person had the skills, the degree would not make a difference. Moreover, the technical skills taught at community colleges seem to be in line with employer demands, as mentioned above. Still, very few people at these large firms have less than a bachelor's degree. We did, however, speak with a few employees without BAs, some of whom had become managers themselves. In all cases, these employees were hired when the company was still young. Most believed that without a four-year degree they would not be hired if they applied for the same position today.

Though it appears difficult for a community college graduate to get a foot in the door at the larger IT firms today, in general those without a bachelor's do not face any limits to their career mobility once they are hired. All promotions are merit based and everyone is on equal footing regardless of their education—with one exception.

In Northern Virginia, a bachelor's degree often does make a difference in an employee's long-term career prospects and upward mobility, simply because of IT government contracting. Because the federal government requires that its contractors use employees with at least a bachelor's degree, a company that hires community college graduates can only use those employees on projects for private clients. This practice not only limits the career prospects of the community college graduate, but it also hurts the

firm as it decreases the cost-effectiveness of hiring that employee and keeping her on staff. Not surprisingly, the faculty of Northern Virginia Community College also acknowledged government contracts as a barrier for their students.

V. Conclusions

Strengths of Current Community College IT Programs

From this very limited look into the complexities of community college IT programs, we have seen several promising features.

1.) Numbers: The sheer number of students taking advantage of community college IT programs signals the continued growth of this field. Enrollments are high for IT classes at these institutions, even if the proportion of students completing degrees and certificates is relatively low.

2.) Program content: The content of community college IT programs appears to be in line with industry needs. Comparing the technical skills that employers require to the offerings of each of the community colleges indicates that the colleges are well tuned-in to the needs of the industry. Moreover, the increasing emphasis on soft skills is one more way that community colleges are adapting to the needs of employers.

3.) Flexibility: The ability to adapt curricula to industry demands in a minimal amount of time makes community colleges particularly well-suited to train students in the rapidly changing field of IT.

4.) Facilities: None of the faculty we spoke with at any college complained of a lack of facilities. Indeed, most benefited from corporate equipment donations and had ample space for computer labs. None of the instructors felt limited by the equipment or

facilities of the college. These colleges are well-equipped to take on more students in years to come.

Weaknesses of Current Community College IT Programs

Some areas where community colleges could use improvement:

1.) Faculty Recruitment: Undoubtedly the biggest problem for IT program directors is finding enough qualified faculty to teach IT classes. One possible solution to this problem would be to facilitate relationships between community colleges and private businesses that would allow IT professionals to remain on the payroll of the their current employer as full-time employees but only work half-time and teach half-time. The community college could then contribute the half-time teaching salary directly to the employer. The employer would then swallow the difference in pay, not the employee.

2.) Career Resources: As discussed above, the career resources at many community colleges are weak. Career centers are a crucial link between employers and students, and need to be strengthened if community college graduates are to get their foot in the door—especially at larger companies.

3.) Employer Links: The most successful IT programs were those with formal employer links. Our case studies showed that those colleges not only receive more financial support but also have more success placing graduates in jobs. Adding internship or special project components to IT programs, as demonstrated by Iowa Western, can only improve career prospects for the students and enhance the reputation of the college in the IT industry and the larger community.

4.) Standards: Few industry-wide standards exist. The skill standards developed by the NWCET are a step in the right direction, but until these standards are widely disseminated, accepted, and used in community college IT training, it will be hard for employers to give up their biases against AA graduates.

From this limited study, we find several reasons to believe that community colleges can make a significant contribution to the future supply of information technology workers. Despite CPS data showing a limited role for associate's degree graduates in IT occupations, data on enrollments and information from our focal colleges offer encouragement. The high levels of enrollment, low graduation rates, and large numbers of older students suggest that community colleges are functioning as retraining institutions rather than primary training institutions. For students who are already in IT occupations, switching careers, or adding technological skills to their current non-IT careers, community colleges are a convenient, economical, and popular option.

As for the quality of the IT programs, this study has found some community colleges with model IT programs—programs that teach the skills that employers demand and open numerous opportunities for their students. With some improvements, such as greater incentives for IT professionals to go into teaching, more active career centers, closer employer links, and the adoption of industry-wide standards, community colleges have the potential to become, if not the leading training suppliers, then perhaps the leading *retraining* suppliers, of tomorrow's IT workforce.

VI. References

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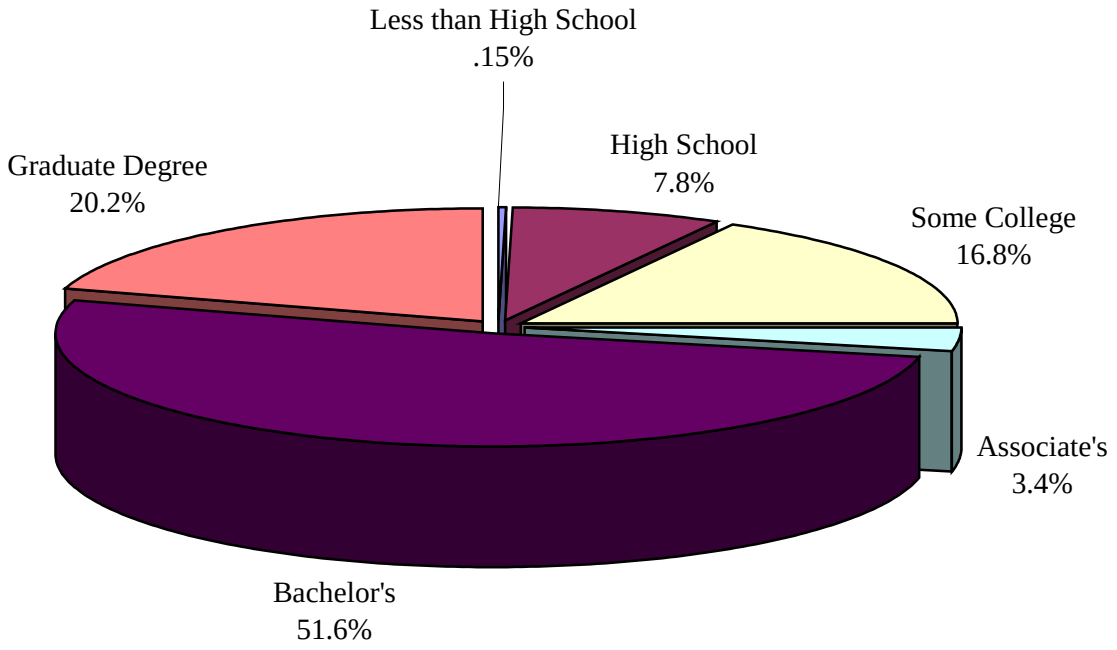
Figure 1: Education of Workers Filling IT Positions Created Between 1994 and 1999



Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Table 1: Education Levels of IT Workers: 1994 & 1999

	1994			1999		
Education	# of IT Workers	% of IT Workers	% of Ed. Category in IT	# of IT Workers	% of IT Workers	% of Ed. Category in IT
Less than High School	11,000	0.66	0.07	12,000	0.51	0.08
High School	141,000	8.45	0.35	195,000	8.27	0.46
Some College	267,000	16.01	1.07	381,000	16.25	1.42
AA	182,000	10.91	1.89	205,000	8.74	1.91
BA	793,000	47.54	3.85	1,143,000	48.74	4.67
Graduate Degree	274,000	16.42	2.71	411,000	17.53	3.49
Total	1,668,000	100.00	1.38	2,345,000	100.00	1.77

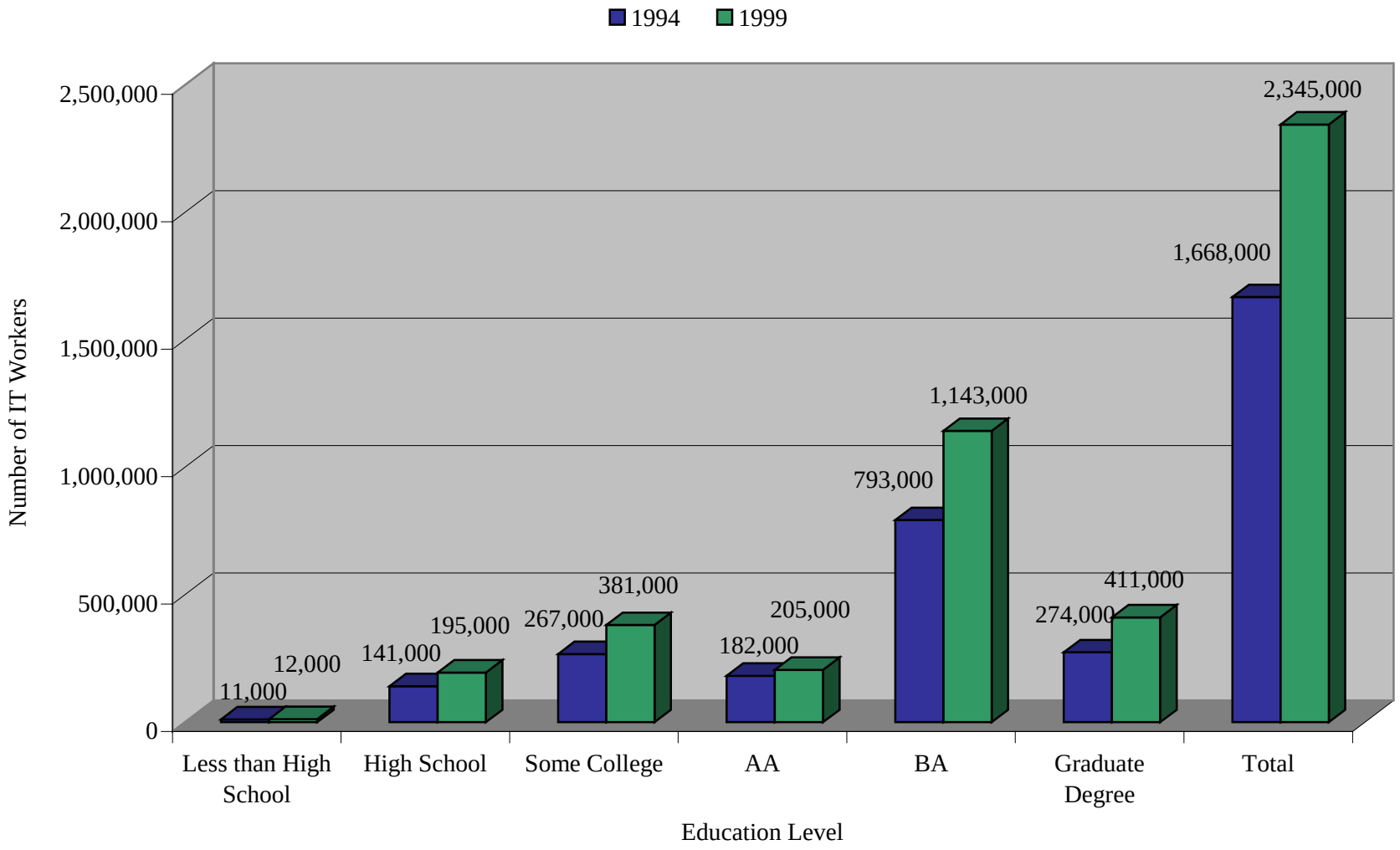
Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Table 2: Education Levels of IT Workers Age 25-34: 1994 & 1999

	1994			1999		
Education	# of IT Workers	% of IT Workers	% of Ed. Category in IT	# of IT Workers	% of IT Workers	% of Ed. Category in IT
Less than High School	3,000	0.43	0.09	4,000	0.45	0.12
High School	49,000	6.98	0.40	48,000	5.45	0.44
Some College	76,000	10.83	1.07	125,000	14.20	1.87
Associate Degree	85,000	12.11	2.55	67,000	7.61	2.12
Bachelor Degree	386,000	54.99	5.22	466,000	52.95	5.70
Graduate Degree	103,000	14.67	4.60	170,000	19.32	6.48
Total	702,000	100.00	1.97	880,000	100.00	2.54

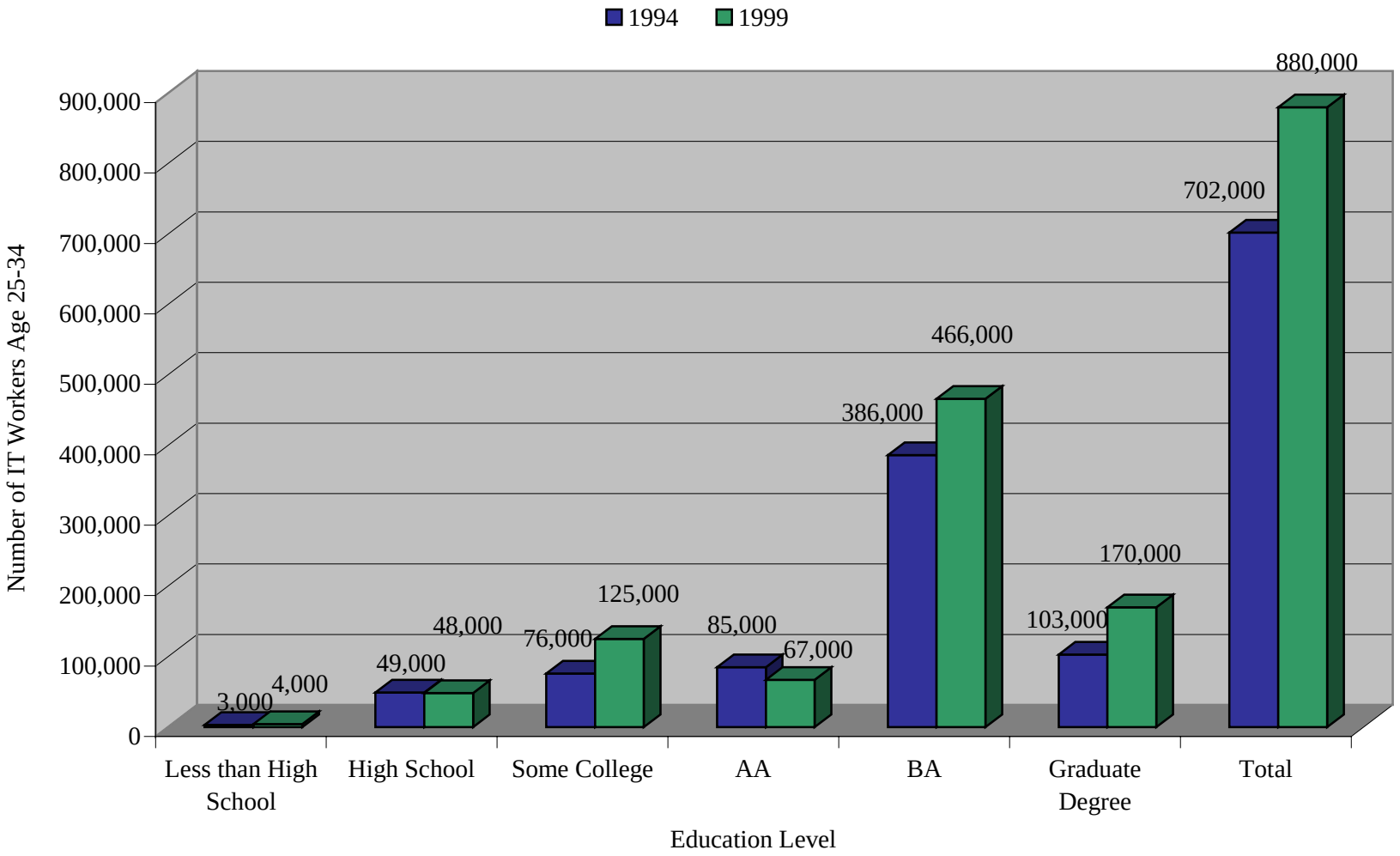
Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Figure 2: Education Levels of IT Workers 1994 & 1999



Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Figure 3: Education Levels of IT Workers Ages 25-34: 1994 & 1999



Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Table 3: Decomposition of IT Employment Growth, 1994-1999

Education	Educational Growth Effect	IT Growth Effect	Interaction Term	Total Effect
Less than High School	0.11%	0.00%	0.00%	0.11%
High School	0.79%	6.59%	0.25%	7.62%
Some College	2.87%	12.98%	0.94%	16.80%
AA	3.09%	0.28%	0.03%	3.41%
BA	21.77%	25.34%	4.70%	51.81%
Graduate Degree	6.68%	11.65%	1.92%	20.25%
Total	35.31%	56.85%	7.85%	100.00%

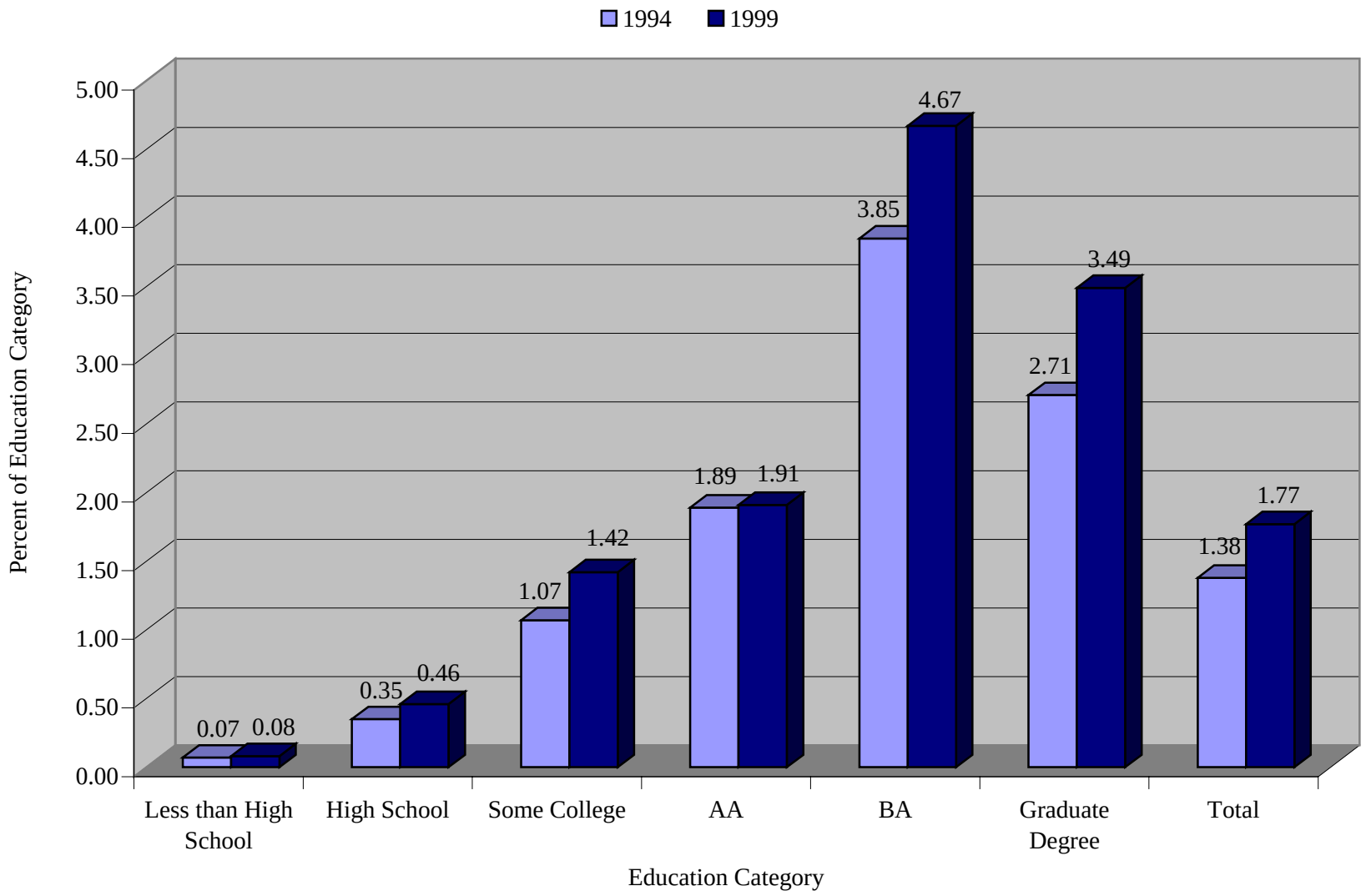
Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Table 4: Decomposition of IT Employment Growth, 1994-1999
Workers Ages 25-34

Education	Educational Growth Effect	IT Growth Effect	Interaction Term	Total Effect
Less than High School	-0.01%	0.57%	0.00%	0.55%
High School	-3.39%	4.71%	-0.34%	-0.98%
Some College	-2.26%	31.95%	-1.69%	28.00%
AA	-2.52%	-8.11%	0.43%	-10.20%
BA	22.63%	20.06%	2.08%	44.78%
Graduate Degree	9.99%	23.78%	4.08%	37.85%
Total	24.45%	71.00%	4.56%	100.00%

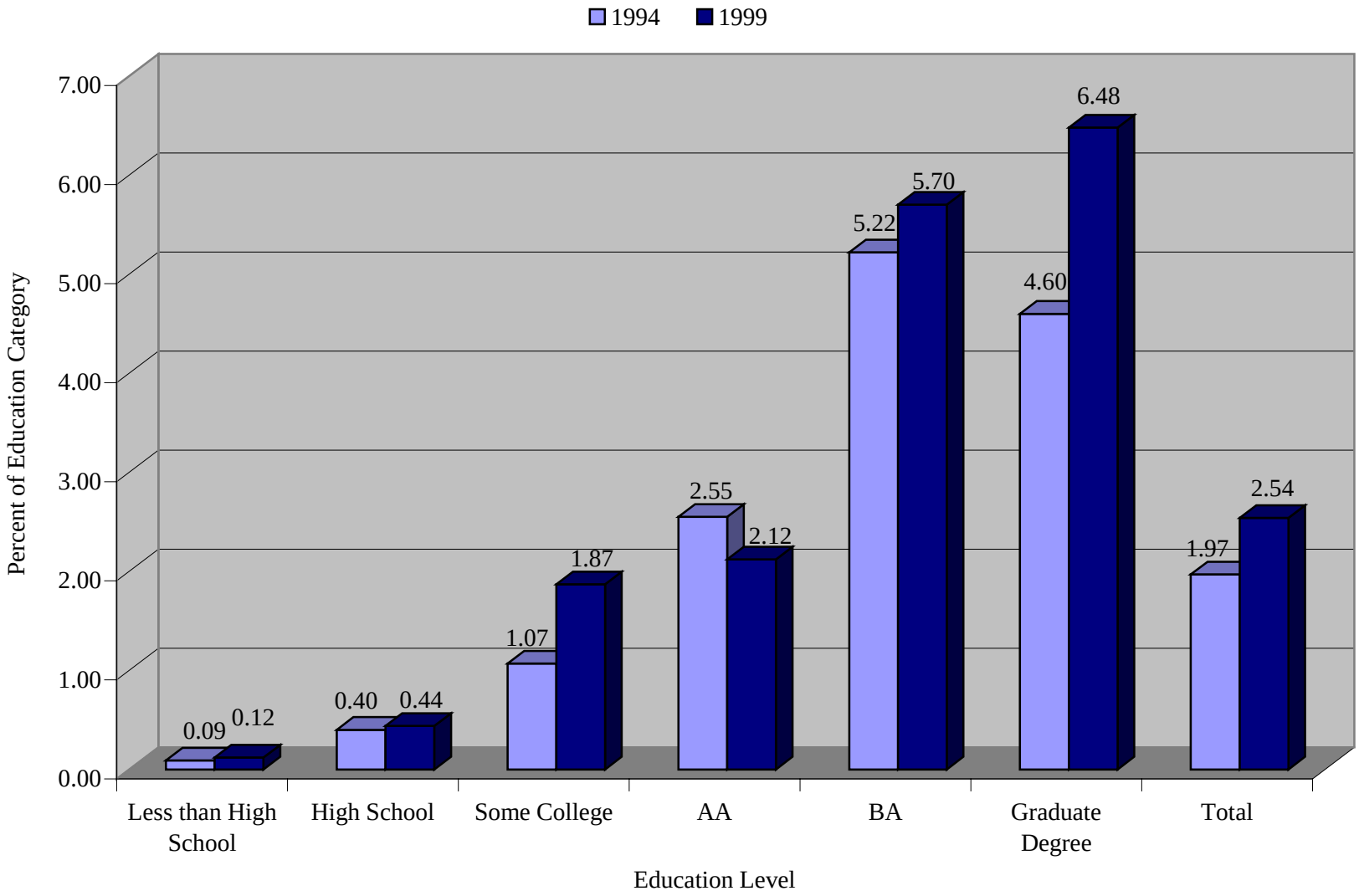
Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Figure 4: Percent of Education Category in IT Jobs: 1994 & 1999



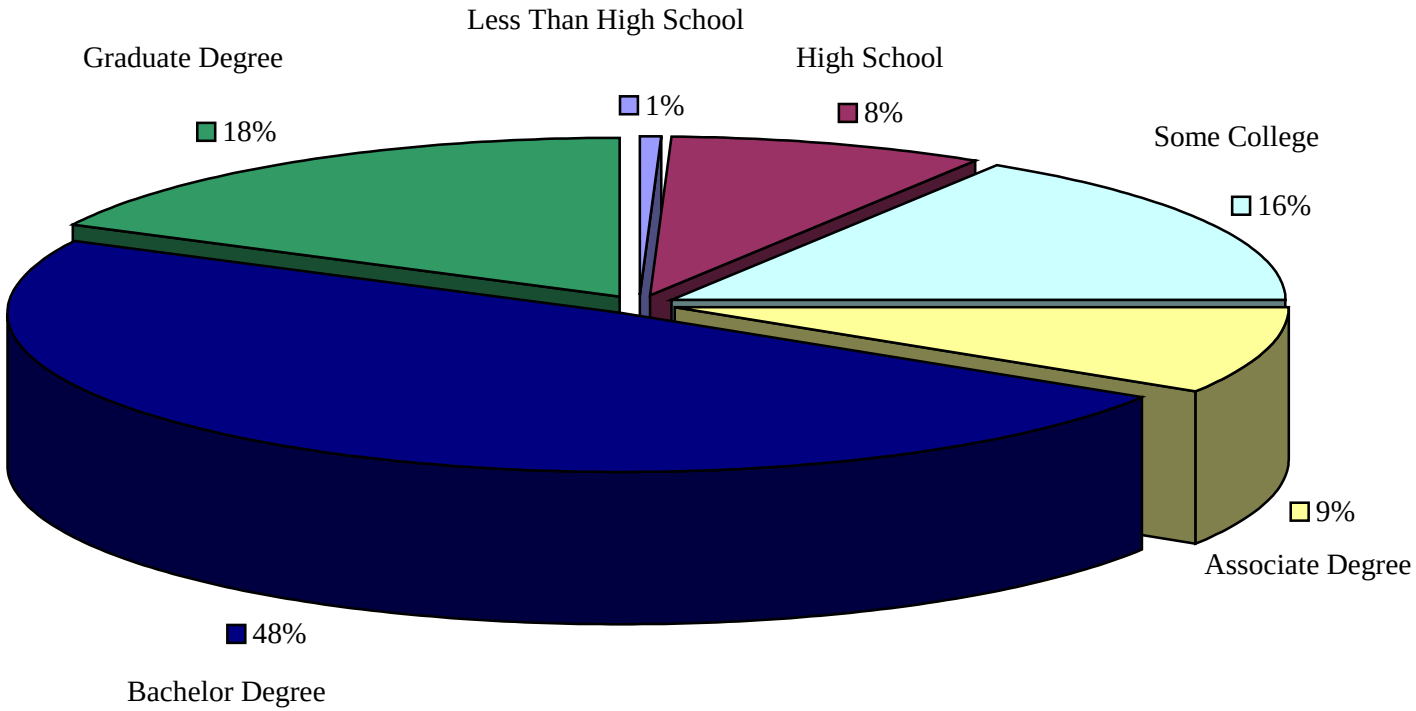
Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Figure 5: Percent of Education Category in IT Jobs: Workers Ages 25-34: 1994 & 1999



Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Figure 6: IT Workers by Education Level 1999



Source: Urban Institute tabulations on data from the January-June Current Population Surveys 1994 and 1999.

Table 5: Community College IT Enrollments 1998

College Name	Total College Enrollment[1]	# of IT Students	IT as % of All Students	# of IT AA Graduates 1997	# of IT Certificates 1997	# of IT Students Over Age 40	% of IT Students with BA
American River College[2]	24,467	6,762	27.63	N/A	N/A	1,870	14.70
Bellevue Community College[3]	11,139 (17,429)	827	7.42	67	21	268	24.00
Iowa Western Community College[4]	4,300	393	9.13	N/A	N/A	N/A	N/A
Northern Virginia Community College[5]	23,603 (36,345)	3,984	16.88	253	10	N/A	N/A

[1] Enrollment data based on program-placed students. Numbers in parentheses show all students including non-program placed.

[2] Source: American River College Student Profile and other tabulations, Fall 1999. IT enrollments include students in computer information systems, electronic technology, and geographic information systems.

[3] Source: Bellevue Community College, Office of Institutional Research tabulations, Fall 1998. IT enrollments include students in media communications and technology, programming, technical support, and administrative office systems.

[4] Source: Iowa Western Community College. IT enrollments include students in computer studies programs.

[5] Source: Northern Virginia Community College Fact Book, Fall 1998. IT enrollments include students in computer science, information systems technology, and information processing