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IT Education and Training for Disadvantaged Students: Lessons from Europe

SUSAN O'DONNELL

Across the European Union, education and training in information technology (IT) is seen as a way to move people experiencing disadvantage – such as the unemployed, people with disabilities, immigrants, marginalized women, and disadvantaged youth – into sustainable employment. All the EU member countries and the European Commission have invested heavily in IT education and training programs for these groups.

The study discussed in this article took place in five European countries, and concluded that for students experiencing disadvantage, IT training and education should be only one element of a much broader pedagogy. Successful programs in the countries studied -- Ireland, the U.K., Finland, Italy, and Spain – used a pathway approach of interventions.

Factors Feeding Growth in IT Training

Since the mid-1990s there has been huge growth in the number of disadvantaged students in IT education and training programs across Europe. This situation can be linked to five factors: high rates of unemployment across Europe, an IT skills shortage, the growth of the IT certification industry, increased places in IT education and training programs, and the entry of community-based employment organizations into the IT training field.

Unemployment

European countries have traditionally experienced higher levels of

unemployment than the United States. Certain demographic groups in Europe are associated with very high levels of unemployment, and the response of European education, training and employment policies has been to fund programs aimed at increasing levels of employment for these “disadvantaged” groups. During the 1990s, European Union employment policy recognized four categories of disadvantage:

- People experiencing social and economic disadvantage for a range of reasons – in particular unemployed people and immigrants and ethnic minorities
- Unqualified and poorly qualified young people
- People with physical, psychological or cognitive disabilities
- Women at work, unemployed or working in their communities

IT Skills Shortage

The second factor was the IT skills shortage. In the mid-1990s, Europe experienced an unprecedented growth in employment requiring information technology skills. Many of the new jobs required technical qualifications related to specific software applications, and candidates with these qualifications were in huge demand by employers. IT skills shortages were widely predicted. The European Commission forecast that 1.7 million jobs across Europe would remain unfilled by 2003 because of the shortage

of skilled workers, particularly in the IT industry [1].

Growth of IT Certification Industry

At the same time, there was a significant growth in the IT certification industry globally. Key players in this industry are large multinational IT companies – such as Microsoft, Novell, Cisco, IBM, Hewlett-Packard and Symantec – that administer certification programs for specific skills in computer software. Millions of candidates have undertaken training in these specific skills and industry-approved examinations testing their technical competence. The European Computer Driving Licence (ECDL) became the world's leading end-user computer skills certification program, with more than 3.5 million participants globally by the end of 2003. In Ireland, the ECDL certification was particularly successful: 250 000 Irish people had undertaken ECDL training and certification by the end of 2003, more than six percent of the entire Irish population [2].

More Spaces in Training Programs

Responding to the IT skills shortage situation, education and training institutions across Europe opened up more places for students and trainees in IT programs. The European Commission encouraged these places through a subsidy program for IT training and education. Governments of many European countries subsidized more

spaces through national programs aimed at getting people back to work. New computer science buildings and IT training rooms sprouted up on university and college campuses, and IT industry certifications were introduced to many university and college programs.

Community-Based Employment Organizations

In addition, a new category of organizations entered the IT training field. These were community-based organizations that provide services for disadvantaged groups. In the mid-1990s, community-based organizations across Europe began offering training in IT skills for the first time. They saw industry IT skills certification programs as a golden opportunity to train unemployed people in these specific skills and find them jobs in companies starved for workers with these skills.

IT Programs for Disadvantaged Students

Two main categories of organizations have been offering IT training programs for disadvantaged students across Europe: public and private sector education and training organizations, and community and voluntary sector organizations.

Public and private sector education and training organizations include universities, colleges, adult education organizations, and training institutes. In the mid-1990s, these organizations began offering IT education and training programs for disadvantaged students as an extension of their ongoing education and training mandate. These programs are largely encouraged by government funding ring-fenced for training disadvantaged students in IT. The education and training organizations are of course familiar with most of the pedagogical aspects of these new programs. For many, the new elements are: providing social supports for large numbers of disadvantaged students, dealing with industry IT certifications, and dealing directly with local employers.

During the same period, a broad spectrum of community and voluntary sector organizations began IT training programs for disadvantaged students.

These programs are an extension of their mandate to offer services and support to disadvantaged groups. The organizations range from small women's organizations and regional voluntary service agencies for people with disabilities to large community-based job centers in disadvantaged urban communities. As community-based organizations, they are familiar with many of the issues facing disadvantaged students. For many, the new elements are: developing an appropriate pedagogical approach, dealing with IT industry certifications, and dealing with local employers.

Many of these community-based organizations envisioned entering the IT training field as a natural progression of their work to increase social inclusion in the information society. In Europe, the term "social inclusion" refers to a process of ensuring that all members of society are able to participate actively in all areas of social, cultural and economic life. The "information society" is understood as a society in which information and communication technologies play a central role. All across Europe, the information society is widely perceived as a society that offers new opportunities for people to engage in social and economic life. Many European community-based organizations and civil society organizations have embraced the notion that information and communication technologies will provide new opportunities for the disadvantaged groups and communities they serve [3].

Examples of IT training and education programs delivered by European universities, colleges, government agencies and community and voluntary organizations in the late 1990s include the following:

- In the U.K., a program that used multimedia and telematics technologies to provide women returning to work with progression routes to higher skills training in IT; a program to deliver a range of IT training courses leading first to basic and then professional-level qualifications in IT for unemployed people.
- In Italy, a program of training in basic IT skills and integration measures aimed at employment for immigrants; a

program of training in IT and other skills aimed at creating opportunities for women in journalism.

- In Spain, a program of training in IT and multimedia for women teleworkers; a program in IT training and other skills aimed at developing women entrepreneurs.

- In Finland, a program of education for people with physical disabilities aimed at improving their career opportunities; a program providing a broad curriculum for unemployed youth including IT skills.

- In Ireland, a diploma in multimedia authoring delivered to Irish-speaking young people in a rural area; a program of IT skills certifications for unemployed people in an urban area. Two of the community-based organizations that delivered these types of programs in the UK and Ireland are profiled briefly below.

Ballymun Job Center, Dublin, Ireland

Ballymun is a disadvantaged community on the outskirts of north Dublin. The Ballymun Job Center is a job placement, training and enterprise development organization set up more than 15 years ago as a community response to the unemployment crisis in Ballymun. The community has about 20 000 residents. Many homes are headed by single mothers and there is intergenerational unemployment. Until recently, rates of secondary school completion were low and very few Ballymun residents were enrolled in third-level education.

In 1996, the Ballymun Job Center began offering IT training programs aimed at industry IT certification. At the time of writing, the organization offers eight different IT programs to community residents: Introduction to Computers, Introduction to Multimedia, PC Hardware Maintenance, WebMaster/E-Commerce, Technical Support Agent, Quality Assurance Tester, Programming, and Certified Professional. Their courses are geared to industry IT certifications ranging from ECDL (European Computer Driving Licence) to MCP (Microsoft Certified Professional).

Manchester Women's Electronic Village Hall, U.K.

In 1992, the Manchester Women's Electronic Village Hall (WEVH) was set up specifically to provide IT training and resources for women in the Greater Manchester area. They have since provided training to more than 1000 women, many of whom are disabled, from ethnic minorities, or with little or no previous formal education and training. A particular feature of the WEVH is that all the trainers and staff are women, and women-only training is their core mandate.

At the time of writing, the WEVH offers 13 IT training programs: including Beginners Computing, Introduction and Advanced Web Design and Publishing, Introduction to Digital Imaging, Advanced Photoshop and Advanced Web Graphics, Web Animation, Introduction and Advanced Desk Top Publishing and Web Technologies for Artists. The courses lead to British certifications accredited by the national certifications agency.

Searching for a Model of Good Practice

A challenge facing educators involved in delivering IT programs to disadvantaged students has been the lack of a model of good practice that combines good pedagogy with an understanding of the needs of disadvantaged students and local employers as well as the implications of using IT certifications.

The funding mechanisms for these IT programs rarely cover the cost of an independent evaluation and the opportunities for learning and sharing good practice are limited. The programs offered by the Irish and U.K. organizations described above were evaluated independently but these evaluations were not widely distributed outside the organizations involved [4], [5].

In 1999, a new European journal was launched that provides a forum for the dissemination of research and practice in the growing field of access, widening participation and the promotion of lifelong learning. *Widening Participation and Lifelong Learning* is a collaboration of two organizations: the

Institute for Access Studies based at Staffordshire University and the European Access Network. The journal has published articles on the support mechanisms for disadvantaged students in higher education as well as university-community partnerships for combating the digital divide [6], [7]. Outside of this journal, however, little academic research has been published related to disadvantaged students and IT.

More recently, reports from the U.K. and a European institution have been published that provide valuable lessons for educators working in this area. They include analyses of ethnic minorities in the labor market [8], business-community partnerships to promote IT [9], supporting access to IT for black and ethnic minority groups [10], and access to employment by vulnerable groups [11].

Outside of Europe, several reports on disadvantaged students and IT have been published, primarily in the U.S. The most well-known report analyzed IT training programs aimed at finding disadvantaged adults jobs in Silicon Valley [12]. However, the positive early results were tempered by another report of difficulties in the Valley for graduates of these programs after the dotcom bust [13]. Another U.S. report provided an overview of IT and youth employment [14].

Short reports on this topic were published by educators at the Center on Education and Training for Employment, Ohio State University. They include analyses of women and minorities in high-tech careers [15], corporate-school partnerships involving IT training programs supported by industry [16], and short-term training programs for welfare recipients [17]. A short report was also published by the Computing Technology Industry Association about the effectiveness for low-income students of one of their certification programs [18].

Pathway Model

In 2001, the European Commission funded a two-year study to identify and develop a model and guidelines of good practice for interventions aimed at assisting disadvantaged Europeans into employment using IT. The study,

conducted in five European countries, was led by Itech Research with research partner WRC Social and Economic Consultants, both based in Dublin, Ireland [19], [20].

The study began by identifying a model of good practice for all employment interventions – a prototype process for moving disadvantaged groups into employment based on interventions proven successful with different categories of disadvantaged people in a broad range of European countries. The researchers analyzed documents produced by the European Commission and organizations across Europe funded by the Commission to deliver employment interventions for disadvantaged groups.

The analysis identified a model of a pathway approach to employment with five key interventions:

1) *Contacting and motivating students:* This intervention ensures that effective outreach mechanisms are in place and that the students are facilitated in every possible way to be aware of and receptive to opportunities.

2) *Developing skills:* This intervention ensures quality training, ideally accredited, the imparting of relevant skills, and as far as possible, targeting to identified job opportunities. Vocational skills are accompanied by developing skills in areas such as literacy and communication.

3) *Ensuring support for social and cultural needs:* This intervention ensures that cultural and other forms of diversity are acknowledged and respected and that all students are empowered to become active citizens through understanding their values, legitimizing prior knowledge and skills, providing information on citizens' rights, and increasing their capacity to participate in decision-making.

4) *Providing employment and career guidance services:* This intervention ensures that employment and career guidance services for disadvantaged students are delivered in a client-friendly and flexible manner, provide good quality information on local employment and education and training opportunities, are accessible and able to support progression and career development.

5) *Developing employment progression measures*: This intervention seeks to secure the actual movement into employment and to support students therein. Specific actions include regular assessment of progress, evaluating and recording learning outcomes, supporting personal planning, familiarization with the local work culture, and supporting mentors and supervisors.

Fieldwork Methodology and Findings

The second part of the study included fieldwork across Europe to explore how organizations were using the pathway model specifically to deliver IT education and training programs. The fieldwork methodology included identifying organizations in five European countries – Ireland, the U.K., Spain, Italy, and Finland – that were delivering these programs and then conducting 48 in-depth interviews with program staff, former students, and employers of former students.

The interviews explored how these education and training programs engaged with the pathway model outlined above specifically in the context of IT education and training for disadvantaged students. The fieldwork was not an evaluation of the programs and the interviews were confidential. The focus was highlighting strategies and good practice. The fieldwork was conducted in 2002; given that the programs had in many cases ended two or more years before the interviews were conducted, lessons were also gathered from interviewees who had more recent experience of similar IT education and training programs.

The organizations studied included six community-based training centers, three community colleges, two private training institutions, two local economic development agencies, a technical university, a national health research centre, a support center for migrant workers, and two national voluntary organizations for people with disabilities.

Most of these organizations were at the time in the early learning stages of developing and delivering IT education and training programs for disadvantaged students. The new interventions

included: providing social supports for large numbers of disadvantaged students, dealing with industry IT certifications, and dealing directly with local employers.

Some of the key findings related to these three interventions are discussed below.

Social Supports for Disadvantaged Students

Students experiencing disadvantage do not usually have the financial resources to participate fully in education and training programs. They also have many social and cultural support needs as students. Programs had to recognize these obstacles and provide support to enable engagement. Programs also had to consider whether cultural and other forms of diversity were acknowledged and respected and ensure that all students were empowered to become active citizens through understanding their values, legitimizing prior knowledge and skills, providing information on citizens' rights, and increasing their capacity to participate in decision-making.

Financial supports such as education and training allowances, travel allowances, and childcare supports are costly, which underlines the need for strong policy that recognize the needs for these kinds of supports. Ensuring low-cost education and training can be a particular challenge for professional IT certifications that are costly to deliver and support.

A quote from one of the interviews from a former student highlights the need for social supports: "For a start you can't expect women to go through these courses without giving them the resources they need right away. One of the big things we didn't have was a computer. Women doing this [training] at this level need a computer at home, even ...lend[ing] ... one for the duration of the course, with maybe an option to buy at a reduced rate at the end if they complete successfully. Also the software – they need up-to-date software. It's very hard for a woman to get out of the house at night to study, especially if you are a single parent, but if you have the resources there you can learn after the kids go to bed."

Ensuring childcare supports was a particular challenge to programs. Of the five countries studied, only Finland provided a good level of state-subsidized childcare support. The lack of affordable childcare was a constraint to participation in education and training programs in the other four countries studied, suggesting that more sustainable childcare options should be explored with students while they are engaged in programs that can then be carried through to employment. One of the difficulties highlighted in the study is that jobs in IT sector industries may not be well-paying until the second or third year of employment and until that time women with childcare duties working in the IT sector may not be able to afford to pay for childcare.

Building peer-support networks while the students are engaged in the program was highlighted as particularly valuable for IT education and training programs. Peer-support networks were created and supported both during their participation in education and training programs and also afterwards, when the support centered on sharing employment information. It was clear from the fieldwork that peer networks needed to be "kick-started" during the education and training programs. Using tutors to facilitate peer-support was widely mentioned in all the countries studied. Tutors also played a role in facilitating peer-support once the program came to an end. In such situations tutors gave encouragement and support to peer groups and encouraged individuals to communicate with one another after the end of the program.

Using Industry IT Certifications

A core challenge for developing IT education and training programs for disadvantaged students is ensuring that the skills needs of the students are balanced with the needs of local employers. On the one hand programs need to be developed with consideration of the particular needs of the students - for example a mix of IT skills and personal development skills for women returning to education will ensure confidence. On the other hand, local employers often have specific needs for IT skills and students without these skills

will not be confident that they will be able to find a job when the program ends.

Ensuring progression routes and choosing the right IT skills certifications posed considerable challenges to programs aimed at delivering higher-level professional IT skills certifications. Three difficulties with IT skills certifications were identified in the fieldwork.

The first is the challenge of gaining recognition of skills certifications. Employers in some areas were slow to recognize the certifications used by education and training programs. The second difficulty is that national certifications developed by state agencies were not always geared to the needs of employers. As well, national qualifications and certifications are developed by government bodies in specific national settings and are not necessarily recognized by employers outside the country. National qualifications were also seen as more general than industry qualifications.

In contrast, industry certifications in the IT field include a range of certifications developed by private sector organizations or foundations – such as the European Computer Driving License (ECDL) the Microsoft MOUS or Certified Professional range of certifications, or the CompTIA A+. The vocational nature of industry-certified courses was seen as valuable. In general, industry certifications are developed to meet the needs of the IT sector or to certify competence with commercial IT products; they are recognized across national borders.

A third challenge however is that the curriculum and exam structure for many of the professional-level industry certifications (such as the Microsoft Professional family) are continually being revised to meet the emerging needs of employers. These ongoing changes made it difficult for education and training organizations to adapt and develop new courses. As well, students in education and training and those who have moved into employment need to keep taking exams as the software develops (for example Microsoft Word 97, Word 2000 and so on), which is an expensive ongoing process.

Of the programs in the countries studied, those in Ireland and the U.K. were most aware of the challenges and opportunities of using IT industry certifications in education and training programs.

A quote from a program staff member interviewed highlights some of the challenges of using IT industry certifications: “If you are going to train people to work in the IT industry they have to have the skills that industry needs. At the minute some of the training courses that governments are promoting are not what the industry needs. Government can't respond as quickly as the industry changes. Certain skills become common and other skills are in demand; training schemes don't change quickly enough. They are still turning out MCSEs when really there are enough MCSEs. What they need to be doing is CISCO programming or XML. But once you set up a training program, for example in XML, it takes you a year to set it up and recruit and another year to train, and by then the industry has moved on to something else.”

Links With Employers

Overall, the weakest element of the pathway approach in the programs studied was engaging with employers. This was acknowledged as vital across all the countries studied but there were few examples of programs doing this successfully or using innovative means to accomplish this.

Networking approaches with local employers and local job centers were highlighted as a way forward. Some programs invited personnel from local job centers and from local industry to give advice to students, conduct mock interviews, and advertise any available positions. This led to strong relationships being formed between educational and training programs and local employers or job centers. These relationships allowed local firms to become familiar with the type of training being delivered in these programs and thus they used the programs as a source of recruitment. An alternative approach was where programs brought students on class visits to local IT firms to give them a feel for the industry.

In some cases there were obvious gaps between the jobs available locally and the program curriculum. The fieldwork highlighted a considerable need for more focused programs aimed at particular types of employment and also programs that would encourage flexible employment opportunities in the IT sector.

Employers were blamed by some program staff for not taking enough interest in disadvantaged students. This finding highlights the importance of measures to improve corporate social responsibility in future pathway models. Of the programs in the five countries studied, those in Finland were more aware of the need to focus on corporate social responsibility measures; for example one program had students communicating and working with local employers to raise their awareness of people with disabilities.

A quote from a program staff member highlights the efforts made by one community college to link with local employers: “As far as employment, we talked a lot about call centers and the kind of jobs they could expect to find in a call center. We built relationships with some of the local call centers and took them out, showed them around and they got careers information at that point. Then some of the call centers came back later on and talked to them further about it and any upcoming opportunities within their call centers. We also had good relationships with employment agencies in this area because a lot of call centers recruit via agencies, and we would ask an agency to come in and talk about the opportunities that they had. Then they would carry out live interviews on our premises for each of the candidates, so people would come in their best gear, have a real interview and be offered jobs on the day in some cases. One of the agencies was given the green light to recruit from [our organization] directly to [name of company] call center.”

Guidelines of Good Practice

The final part of the study was analyzing the fieldwork findings and developing a set of guidelines of good practice. The analysis considered not only the three interventions discussed above, but also

the range of issues across the five main interventions of the pathway model outlined earlier.

The guidelines are listed below under each of the five interventions. They will be useful for educators developing and delivering IT education and training programs for students experiencing disadvantage.

Guidelines for Contacting and Motivating Disadvantaged Students

First Contact

- In providing information on IT-related courses available, language should be kept simple and the use of jargon avoided.
- Successful past students who have made careers in the information society can be recruited to spread the word to potential students about the benefits of participation in education and training.

Taster Sessions

- Community-based open days involving IT taster sessions can help overcome fear of IT education and training environments.
- Small group sessions, emphasizing the creative and fun aspects of IT and facilitated by supportive staff, can help allay fears about IT and returning to education.
- Conducting taster IT training courses for potential students in their own homes, or in their local communities, are particularly useful for people with low self-esteem.

Student Selection

- Informal interviews with potential students and basic IT tests are better than structured interviews and complex IT skills assessments for demystifying new technologies and assessing capabilities.

Guidelines for Developing Skills

Mix of "Soft" and Technical Skills

- Practical and soft skills required by students include communication skills, confidence building, personal development, teamwork, job search,

writing letters of application, mock interviews, and developing CVs.

- The provision of practical and soft skills should also seek to improve students' ability to deal with discrimination in IT sector employment.
- Students need to be made aware of employers' needs in relation to soft skills and practical skills and that these skills are just as necessary as IT skills to ensure sustainable employment in the information society.

Industry Certifications

- Appropriate certification can help ensure progression routes, but challenges arise in regard to a) ensuring that employers will recognize certification awarded, b) ensuring that national systems of accreditation are compatible with industry standards, and c) finding mechanisms to ensure that training provision keeps abreast of industry developments.
- It is important to ensure that local employers recognize and value the IT skills certification provided by education and training programs and that these are targeted at the needs of local employers.
- Where professional IT certifications are provided, a careful choice is necessary between the range of industry certifications and national qualifications. For both, it is important to ensure that education, training and certifications are responsive to the needs and developments within business and industry.

Trainers

- The choice of trainers is crucial in providing a supportive training environment. Practical, hands-on experience and role-playing methods are valuable approaches.
- Trainers of technical, soft and practical skills, in addition to teaching skills and the ability to empathize with and be sensitive to students' needs and understand their cultural contexts.

Training Delivery

- IT training should concentrate on face-to-face delivery and personal contact and support. Where IT is used to

deliver training, the focus should be on practical work uses and be task oriented. Examples of this are using the Internet for research and job searching.

- While a range of IT applications can be used for education and training programs, some solutions may not be suitable for certain groups of students: for example women returning to education may prefer to leave their homes for training rather than avail of distance learning methods via the Internet or videoconferencing.

Organizational Capacity

- Small community-based organizations, which can play an important role in reaching out to and engaging disadvantaged students, may not have the necessary IT infrastructure to deliver training programs. Strategic partnerships at local level could help ensure co-operation between relevant actors.

Progression Routes

- It is important that the transmission of technical skills can accommodate progression routes for students, both within education and training and within employment.
- Skills training programs should be mindful of the entrepreneurial opportunities that exist and should seek to develop skills in this area.

Guidelines for Providing Cultural and Social Support

Factoring-In Costs

- The costs associated with providing cultural support and more particularly with providing social supports must be factored into education and training programs. Childcare costs and transport costs are just two of the potential barriers to participation that disadvantaged students face.

Peer-Support Networks

- It is important to develop peer-support networks that can be maintained after education and training programs end. Such networks allow former students to share experiences and strategies for dealing with discrimination

in IT sector employment and further IT skills training in employment.

- There is good potential to use Internet for peer-support networks; this highlights the need to ensure that Internet skills are developed during the time the student is part of the program and that Internet access is assured afterwards.

Information on Cultural Integration

- There is good potential for using IT tools for information on cultural integration and multiculturalism and for using Web-based information generally for citizenship information; however this information needs to be updated regularly to remain useful.

Information on Workplace Rights and Responsibilities

- The provision of information on employer and employee rights and more generally on employment rights is particularly relevant as much of the IT sector does not have trade union representation and students may not otherwise have access to this information.

- The provision of information on corporate social responsibility, particularly on the need for more flexible and part-time employment opportunities in the IT sector, is a valuable dimension.

Guidelines for Providing Employment and Career Guidance Services

- Provide information to students on discrimination that may be experienced by employees in the IT sector, and particularly by women.
- For programs delivering industry IT certifications, students need to be aware of the ongoing cost of taking new exams and keeping up the certification in employment.
- Provide up-to-date information on specific IT skills training progression paths for IT sector occupations.
- Practical information is needed on salaries and progression in IT employment that would allow students with childcare responsibilities (usually women) to make practical choices about whether they can afford to work or how best to combine work with childcare responsibilities.

- Provide information on local flexible and part-time employment opportunities in IT fields.

- There are good possibilities for making this information available on the Internet as an integral part of an education and training program. It is vital that this material is updated regularly. Students can use the Web to find employment and career information but they will need to be guided as the information may be outdated and not related to local needs.

Guidelines for Developing Employment Progression Measures

- Programs will need to make a focused and proactive research effort into the skills needs of local employers, both for IT skills and soft skills. This research process may be a good way to engage with and build stronger links with employers.
- Strategies for work placements should be developed that involve closer contact between the employer and programs to ensure placements are tailored for specific IT skills certifications.

Developing Linkages is Vitally Important

The programs studied here were developed and delivered by community-based training centers, community colleges, private training institutions, local economic development agencies, a technical university, research centers, support centers and national voluntary organizations.

This study indicated that the pathway model is relevant for IT education and training programs for disadvantaged students. The findings suggest that disadvantaged students may have more difficulty accessing IT-related jobs than jobs in other sectors, for several reasons. First, information on the types and variety of career options available in the IT sector is not readily available to many women and men experiencing disadvantage.

Second, potential students experiencing disadvantage may hold the misperception that employment in IT sector jobs necessarily involves very advanced levels of education and

training, when this is not always the case. Finally, ongoing technological developments have meant that career paths and opportunities can change and develop much more quickly in IT-related jobs than in other sectors.

For all these reasons, developing adequate linkages between education and training interventions and local employers is vitally important. IT training and education programs can become outdated and irrelevant if they fail to keep abreast of changes in business and industry.

The study also clearly demonstrated the importance of including vocational, practical, and soft skills in the program curriculum. It is important to underline this point because the necessity for IT training may overshadow the equal need for soft and practical skills for disadvantaged students.

Many of the lessons learned from Europe may be relevant to IT education and training programs more widely internationally. Clearly, IT education and training for disadvantaged students remains an undeveloped research area. Future research could build on the European findings and explore the issues raised in a broader range of cultural and educational contexts.

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