Online Publication Date: 16 January, 2012

Publisher: Asian Economic and Social Society

Digital Equity: Causes and measurement

Ramesh Rao (Department of Research & Development Specialist Teacher Education Institute Ministry of Education Malaysia)

Citation: Ramesh Rao (2012): "Digital Equity: Causes and measurement" International Journal of Asian Social Science , Vol.2, No.1,pp.44-51.

International Journal of Asian Social Science, 2(1), pp. 44-51

Digital Equity: Causes and measurement

Author (s)

Ramesh Rao
Department of Research & Development Specialist Teacher Education Institute Ministry of Education Malaysia.

Email: rameshrao08@yahoo.com
Phone: 6017-8792159

Key Words: Digital equity, digital divide, adult learners, Gini coefficient

Abstract

Digital divide among students has become a concern to many governments. Previously digital divide (DD) is seen as the difference between those who own a computer with those who don't. But this has changed to how much technology access is done by someone. Thus measuring this digital divide has moved from computer ownership to technology accessing. This has also caused the issues involved in measuring DD to change, and leads to terms such as Digital Equity (DE). In this paper, the issues which should be included when measuring DE are discussed. Along with this, Gini coefficient, an approach commonly used in measuring income distribution is shown on how it can be used in measuring DE.

Introduction

Among the educational resource which is gaining importance is technology (Anderson, *et.al* (2001). The evolution of technology had changed the way teaching and learning is carried out. The ever changing technology (as shown in Table 1) could create an imbalance in a society. Researches had shown that, developments in technology had reduced employment opportunities for older workers (Aubert, Caroli & Muriel, 2006). Although the role of technology in influencing the learning and teaching process in education is disputed but its presence is felt necessary. This makes it important that technology is made available to every student.

In the case of school students, it would be the responsibility of the authorities in providing the technology to every student. On the contrary, for adult learners the onus is on the learner himself and not others. Adult learners are people who have finished their secondary education and pursuing their education. Many adults pursue education because they believe it will enhance their employability and eventually increase earnings (Wiseman, 1987). Innovations and advancement in technology had enabled many working adults to pursue their education. Computer assisted learning environment has helped adult learners in coping their education (Thompson & Savenye, 2007).

The usage of computers by learners has changed over time. In the past computers were used by students for the purpose of preparing the written assignment and others (Volman & Van Eck, 2001). With the advancement of ICT, usage of computers had expanded rapidly. This poses a problem to many educational institutions which provide distance education where dependence on technology is high.

Much of the problem is caused by the digital divide among the students of an institution. Digital divide (DD) is also known as digital equity (DE) (Becker, 2006). Digital divide is defined as the different use of technology in education based in ethnicity and socioeconomic status, while DE refers to the activity of ensuring that all students have the same amount of access to information and technology for learning (Judge, Puckett & Cabuk, 2004). The term DD began to appear in American vocabulary back in the 1990's (Light, 2001).

Instead of using the term DD, some writers prefer to use the term DE because of the wider coverage it gives (Solomon, Allen, and Resta, 2003). DD refers to the people who have/own a computer with those who don't (McGrath, 2005). In this paper DD and DE are used interchangeably. Violation of DE could lead to a serious repercussion in a society. If DE is not achieved in education, it could jeopardize the provision of education to all (First & Hart, 2002). However achieving DE is not an easy task. There are many questions which must be answered when "equity" is involved.

Many results on studies of DE are often rebutted because the way DE is operationalized and measured. In this paper, issues in measuring DE and one way of measuring DE are discussed.

Table 1: ICT's and their potential for education

Technology	Outreach	Flexibility	Interactivity
Radio	High	Limited	Limited
Television	High	Limited	Limited
Video	Low	Limited	Limited
Personnel Computers	Low	High	High
Internet	Highest	High	Highest

Source: Adapted From Mar, 2004

Issues in Digital Equity

age

Some of the adult learners had left schools for some time. One of the reasons on why teachers do not adapt to new teaching techniques in delivering their lesson is because they are influenced on the way they were taught during their schooling days. This shows that technology assimilation among older people is slower compared to younger people (Morris & Venkatesh, 2000).

Research in cognitive sciences had shown that there is a relationship between age and technology adoption in learning. Younger people are more receptive in adapting changes in the way they learn compared with older people (Bosma et al., 2003). Since the age of adult learners varies, any study on the DE should consider age as a factor.

Gender

Attitudes and perceptiveness of technology is different between the sexes. While males perceive technology positively and easy, female thinks it as otherwise (Menard-Warwick & Dabach., 2004, Bain & Rice, 2007; McKinney et.al, 2008). Lack of interest and participation of girls and women in technology had prompted the formation of AAUW Educational Foundation Commission on Technology, Gender, and Teacher Education in 1998 (AAUW, 2000).

Many countries are facing a gender imbalance in student enrollment. As shown in Figure 1, many ASEAN countries are having higher enrollment of girls than boys at tertiary level enrollment. Many studies on DE, does not take whether the results would be different if gender was included in the computation of the value. Many adult learners are enrolled in tertiary level programs. Since the probability of more females than male students is higher, any measurement on DE should take note of this.

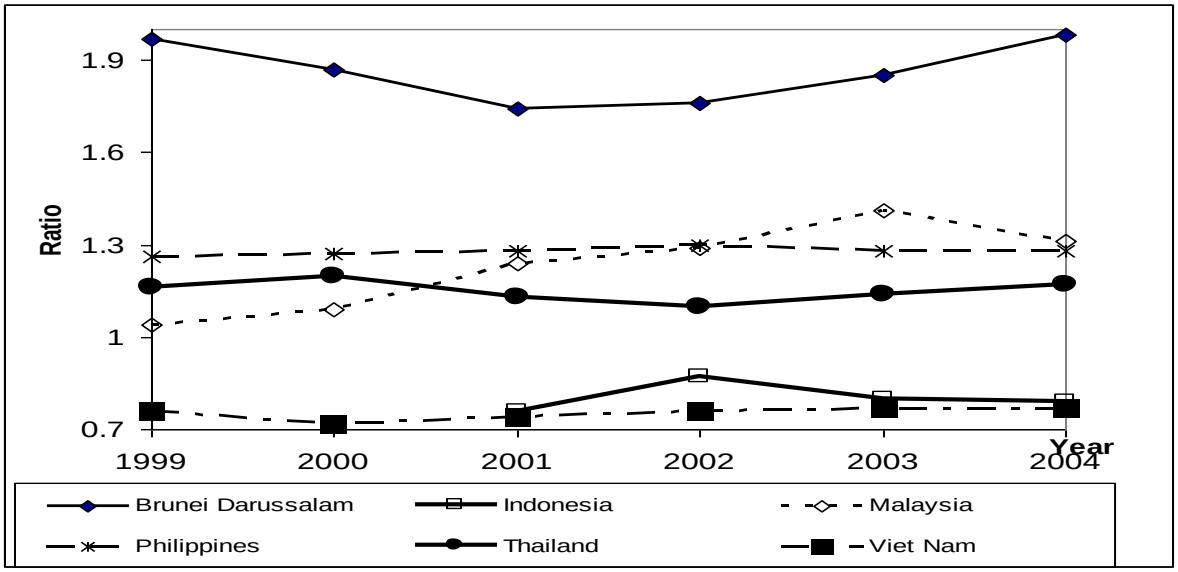

Figure 1: Tertiary Level Enrollment: Girls to Boys Ratio (ASEAN)
Source: UN
Note: Values more than 1 indicate, girls are more than boys

Income

There is a correlation between income and technology (Frank, 1995). Since technology is not a public good, owning a computer itself will consume some of the income (Kalyanpur & Kirmani, 2005). Technology utilization usage especially internet and broadband facilities will require an individual to bear the expenses incurred. Although this sum could be minimal but when the person's income is low, it could be of a significant portion.

Table 2 shows the correlation between computers per 1000 with the household income for selected countries. In countries where household income is low, computer ownership is highly significant. But in developed countries such as Belgium and Sweden, computer ownership does not really depend on household income. This could be because the amount of income, in terms of percentage, devoted for computer is small in developed countries compared in developing or undeveloped countries.

Table 2: Correlation between computer ownership and household income

Country	Significance Level
Austria	√
Belgium	X
Brazil	√
Chile	√
Denmark	X
India	√
Indonesia	√
Malaysia	√
Philippines	√
Singapore	X
Sweden	X

Source: Computed by author based on data provided by UN

Note: √ = Significant
X = Not significant

Since most adult learners are working, thus their income level could hinder their use technology. The amount a person could allocate or spend on technology access depends on the amount of his/her disposable income. When a person's disposable income is high and the cost of accessing technology i.e internet, is low, thus proportionately it is low would encourage an adult learner to utilize technology. Ultimately the cost of accessing technology would not jeopardize his/her consumption on other goods. On the other hand, if the proportion is high it would force the adult learner to do some sacrifice in consuming or purchasing other goods. Although one could argue, that being a student, priority should be given to education, but being a human being who are subjected to needs and wants, this could be easier said than done.

location

Technology access in the internet era had move beyond the need for hardware (equipment) and software (programs) alone. It is possible to provide both these components in any part of the world. However to increase the access to technology, especially to internet, what is needed is a good transmission network (Camper *et.al*, 1994). Set up cost of such networks are costly. Quite often the network providers are bound to economic cost, thus the availability of such technology is limited to urban areas and where there is a market for such services.

Figure 2, shows that technology availability and usage do depend on the size of the country. Small countries such as Singapore show that technology availability is so high that there are many Singaporeans who own more than 1 telephone line (the value for Singapore is 132.7). Figure 2 shows that most ASEAN countries had began to invest more in technology i.e telephone lines.

In the case of Malaysia, internet access especially broadband service is limited to certain part. But adult learners are scattered throughout the country. When computing DE, location of a learner must be taken into consideration. This is because, DE occurs not because the learners does not want to access to technology but infrastructure deficiency could hinder one from doing so.

Marital status

One of the factors on why DE occurs is because of females need to play a dual role in life. In the education environment, their dual role of being a student and a housewife or daughter could cause a disadvantaged situation to the female. In many societies, girls face greater hurdles in seeking education. In fact in many developing countries, studies had shown that girls still lag behind boys in education (Liu, 2004). Their role is further aggravated if they are married thus limiting the time for the usage of computers or access to internet (Leigh-Doyle, 1991).

The "playing field" is made worse when the adult learner is not only married but also has children. The number of children and the age of the children too will influence the technology access time of the adult

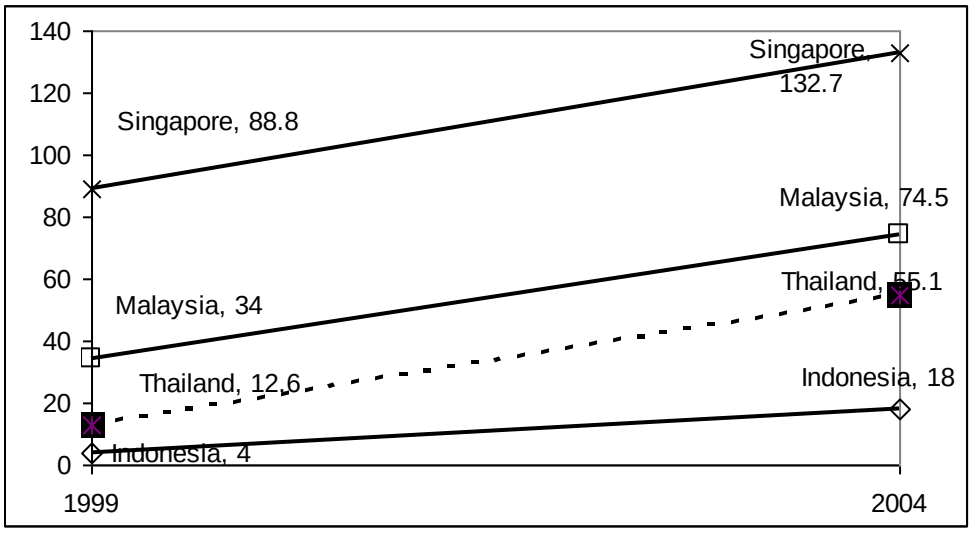

Figure 2: Telephone lines and cellular subscribers per 100 population
Source: UN

learner. Quite often many adult learners especially woman cite they are only able to use their personnel computers after their children, especially toddlers, are sleeping! Other than children, the spouse of the adult learner too will influence the amount technology access (Hull, 2001). The role of the spouse in influencing technology access is more obvious when the learner is female. As shown earlier, male are more technology savvy then female.

Thus, when computing DE marital status of a learner must be taken into consideration. This is because it is not fair to include all adult learner into a single unit when the "playing field" i.e access time, is not the same for married and unmarried learners.

Job nature

Most of the adult learners are people who further their studies on part-time basis. Many of them attend classes either at night, weekends or at interval periods. Many educational institutions rely on technology to facilitate the learning and teaching process for these adult learners.

However, the job nature of many of these adult learners could influence technology access time. Jobs such as sales and marketing would require the learners to be out of office. Although wireless technology would enable a person get connected to internet but still he/she would need to find the time to do. On the other hand, if the job of the adult learner is a "desk job", then the chances he/she accessing the internet is higher. Thus, when evaluating DE, the nature of the job should be included in measuring it.

Exposure to technology

Adult learners are students who had left secondary schools. Some of these adult learners would have left schools many years ago when computers and internet were unheard of, while some would be from the era where computers and internets are a norm. Existence of both these groups in a society has spurred many studies on DE. In many countries, schools are expected to expose their students to computer technology (Becker, 2000). However due to financial constraints some schools are unable to do so.

Even when schools which have computer facilities, does not necessarily mean their students are exposed to the latest technology. This is because, one of the major obstacles face by many school in exposing their students to technology is the pace of changes taking place. Many schools noticed that by the time they have built up their computer inventories, technology had moved leaving the technology they have acquired is either outdated or obsolete (Becker, 2000).

To cater to this wide range of "technology exposed students", many educational institutions would offer a refresher course. Normally these refresher courses are conducted by the "resource centre" of the

institution. The questions raised in such endeavor is could the students who had never been exposed to technology would be equally competent with students who had been exposed since school days?

Thus, when computing DE for adult learners, exposure to technology should be taken as a factor. This is because it is not fair to compare an individual who had been using computers since his schooling days with students who are using it for the first time.

Language mastery

English is the main language used in internet (See Table 3). Most of the materials in the internet use English as the medium of instruction. This hinders some people from using the internet. Even in countries where there is internet facilities, proficiency in English could discourage some from accessing the internet. As shown in Table 4, among the ASEAN countries, only Filipinos uses English in when online. Countries such as Indonesia and Malaysia, other language are more widely used.

Thus, adult learners in these countries could face some difficulties when accessing the internet. Since most of the materials are not in their familiar language, it poses a problem in comprehending the materials found through the internet. In the long run many adult learners become discouraged in using the technology because of this. Therefore when evaluating DE, language mastery especially English should be taken as a factor.

Measuring Digital Equity

Many previous studied had used "computers" to measure DE. However, the results obtained might not really reflect the actual inequity. By just counting the number of computers it gives a false sense of how adult learners are accessing to the internet (Tucker, 2007). One method of measuring DE is by utilizing Gini Coefficient.

Gini coefficient is one of the most famous measurements of equity used by economist (King, Swanson & Sweetland, 2003). It is used in analyzing and assessing the distribution in a population. Economist uses it in measuring income inequality in a population. Other than measuring income distribution, it had also been used in measuring educational resources (Berne & Stiefel, 1984). The value of Gini coefficient varies between 0, which reflect perfect equity and 1, which indicates complete inequality. Graphically, the Gini Coefficient is represented by the area between the Lorenz curve and the line of equality (See Figure 2). The shaded area or the value of Gini coefficient could be computed as

$$G = \frac{\sum_{i=1}^{n}(2i - n - 2)\ X_i}{n\sum_{i=1}^{n} X_i} \qquad [1]$$

Where X = computer access
n = population (age, gender, income etc)
i = rank of the population in ascending order

Gini coefficient was used by the authors "A Nation Online" to study trends in the inequality of Internet use among various groups. Summary of the findings is shown in Table 5. Gini coefficient would be able to include the issues mentioned earlier when computing DE. For example, to measure to determine whether sex is influential in DE, the horizontal axis could be set for age and sex. Data on amount of technology access is arranged in ascending order by age and sex. (Figure 3 shows a hypothetical Lorenz curve of such data)

Conclusion

By taking into consideration factors that influence DE among adult learners, it would be possible for curriculum designers to incorporate the findings. Adult learners should be given all the necessary encouragement in pursuing their education. By taking into consideration the factors affecting DE among the, methods on evaluating them could be designed in such a way that would be beneficial to both the learner and teacher. However this does not mean that different standards should be set for adult learners with various characteristics but concessions should be thought of. For example, a more flexible time of completing a study programme should be given to adult learners with different characteristics. Studies which could incorporate the factors which influence technology access among adult learners would give a more accurate picture of DE.

Table 3: The 10 Most Highly Represented Languages on Web Pages (2000)

Language	Web Pages (in millions)	Percent of total
English	241.250	68.39
Japanese	18.336	5.85
German	18.070	5.77
Chinese	12.114	3.87
French	9.263	2.96
Spanish	7.573	2.42
Russian	5.901	1.88
Italian	4.883	1.56
Portuguese	4.291	1.37
Korean	4.046	1.29

Source: Gorski, 2005.

Table 4: Number of people online in each language (2004)

Country	Language Analysis (in millions)				Total
	English	Chinese	Malay	Thai	
Indonesia			8.1		8.1
Malaysia	0.2	2.9	5.8		8.7
Phillipines	3.5				3.5
Singapore	0.2	2.1	0.3		2.6
Thailand				7	7

Source: Global Reach, 2006

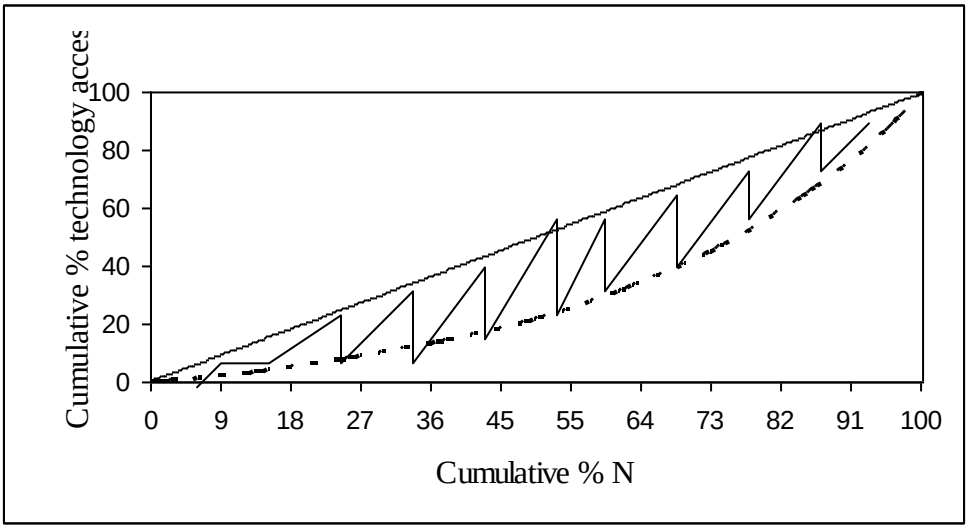

Figure 2: Lorenz Curve

Table 5: Value of Gini Coefficient: Internet Usage

Internet Use based on	1998	2001
Income	0.361	0.254
Level of education	0.364	0.262
Occupation	0.374	0.303

Source: U.S. Department Of Commerce, 2002

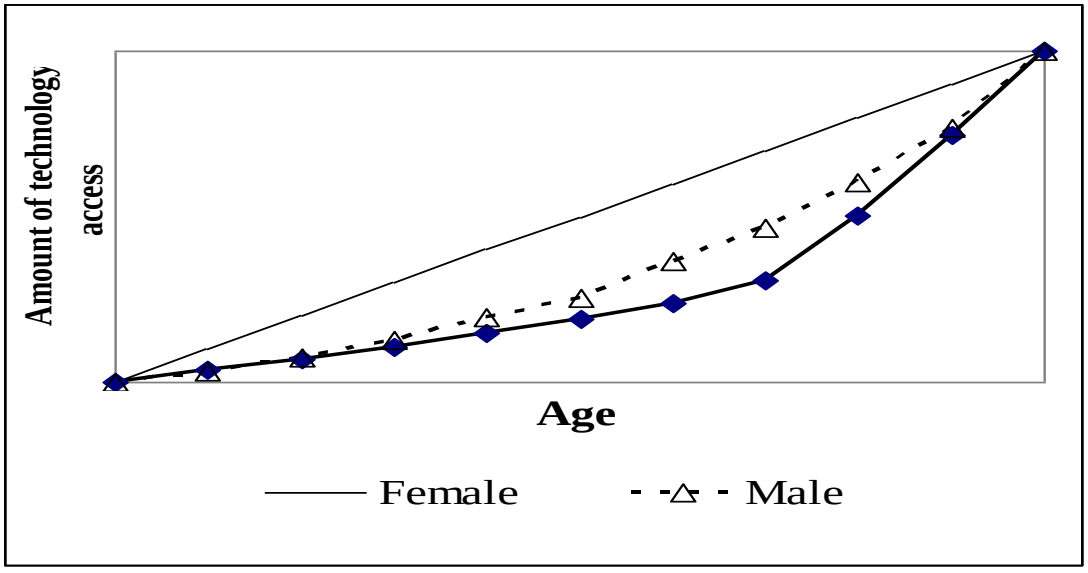

Figure 3: A Hypothetical Lorenz Curve showing inequity between Gender

References

AAUW. (2000) Educating Girls in the New Computer Age By the, Gender, and Teacher Education. Washington: AAUW Educational Foundation Commission on Technology.

Anderson, L., Briggs, A. R., & Burton, N. (2001) Managing Finance, Resources and Stakeholders in Education: Paul Chapman Publishing.

Aubert, P., Caroli, E., & Roger, M. (2006) "New technologies, organisation and age: firm-level evidence" Economic Journal, Vol.116, No.509, pp.73-94.

Bain, C. D., & Rice, M. L. (2007) "The Influence of Gender on Attitudes, Perceptions, and Uses of Technology" Journal of Research on Technology in Education, Vol.39, No.2, pp.119-132.

Becker, H. J. (2000) "Who's wired and who's not: Children's access to and use of computer technology" The Future of Children, Vol.10, No.2, pp.44-75.

Becker, J. D. (2006) "Digital Equity in Education: A Multilevel Examination of Differences in and Relationships between Computer Access, Computer Use and State-level Technology Policies". Education Policy Analysis Archives, Vol.15, No.3, pp.1-36.

Berne, R., & Stiefel, L. (1984) The Measurement of Equity in School Finance: Conceptual, Methodological, and Empirical Dimensions. USA: The John Hopkins University Press.

Bosma, H., Boxtel, M. P. J. V., Ponds, R. W. H. M., Houx, P. J. H., & Jolles, J. (2003) "Education and agerelated cognitive decline: the contribution of mental workload" Educational Gerontology, Vol.29, No.2, pp.165-173.

Camper, E. J., Giles-Gee, H., Johns, M. E., & Lecca, P. J. (1994) "Technology access and quality" The Educational Record, Vol.75, No.3, pp.47-51.

First, P. F., & Hart, Y. Y. (2002) "Access to cyberspace: The new issue in educational justice" Journal of Law and Education, Vol.31, No.4, pp.385-412.

Frank, J. (1995) "Preparing for the information highway: Information technology in Canadian households" Canadian Social Trends Vol.38, pp. 2-7.

Hull, B. (2001) "Can librarians help to overcome the social barriers to access?" New Library World, Vol.102, No.10, pp.382-388.

Judge, S., Puckett, K., & Cabuk, B. (2004) 'Digital Equity: New Findings from the Early Childhood Longitudinal Study" Journal of Research on Technology in Education, Vol.36, No.4, pp.383-397.

Kalyanpur, M., & Kirmani, M. H. (2005) "Diversity and Technology: Classroom Implications of the Digital Divide" Journal of Special Education Technology, Vol.20, No.4, pp. 9-18.

King, R. A., Swanson, A. D., & Sweetland, S. R. (2003) School Finance: Achieving High Standards With Equity And Efficiency. Boston: Allyn and Bacon.

Leigh-Doyle, S. (1991) "Increasing Women's Participation in Technical Fields: A Pilot Project in Africa" International Labour Review, Vol.130, No.4,pp.427-444.

Light, J. S. (2001) "Rethinking the digital divide" Harvard Educational Review, Vol.71, No.4, pp.709-735.

Liu, A. Y. C. (2004) "Flying Ducks? Girls' Schooling in Rural Vietnam: A Revisit" Asian Economic Journal, Vol.18, No.3, pp. 293-318.

Mar, N. Y. (2004) "Utilizing Information and Communication Technologies to Achieve Lifelong Education for All: A Case Study of Myanmar" Educational Research for Policy and Practice, Vol.3, No.2, pp.141-166.

McGrath, L. (2005) "Crossing the Digital Divide: Race, Writing, and Technology in the Classroom" Issues in Writing, Vol.16, No.1, pp. 82-86.

Menard-Warwick, J., & Dabach, D. B. (2004) "In a little while I could be in front": Social mobility, class, and gender in the computer practices of two Mexicano families. Journal of Adolescent & Adult Literacy, Vol.47, No.5, pp.380-390.

McKinney, V. R., Wilson, D. D., Brooks, N., O'Leary-Kelly, A., & Hardgrave, B. (2008). "Women and Men in the IT Profession". Communications of the ACM, Vol.51, No.2, pp. 81-84.

Morris, M. G., & Venkatesh, V. (2000) "Age Differences In Technology Adoption Decisions: Implications For A Changing Work Force" Personnel Psychology, Vol.53, No.2, pp.375-403.

Solomon, G., Allen, N. J., & Resta, P. (2003) Toward digital equity: Bridging the divide in education. Boston: Allyn and Bacon.

Thompson, E. W., & Savenye, W. C. (2007) "Adult Learner Participation in an Online Degree Program: A program-level study of voluntary computer-mediated communication" Distance Education, Vol.28, No.3, pp.299-312.

Tucker, P. (2007) "A New Ruler for the Digital Divide" The Futurist, Vol.41, No.2, pp.16.

Volman, M., & Eck, E. v. (2001) "Gender equity and information technology in education: The second decade" Review of Educational Research, Vol.71, No.4, pp.613-634.

Wiseman, J. (1987) Public Finance in education. Oxford: Pergamon Press.