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An explorative study of the digital divide in education: another look at Taiwan

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ABSTRACT: The fast development of information technology has rapidly changed people's lives and provided benefits in many different ways. However, negative influences of the digital divide have appeared. In trying to bridge the digital divide, the Government of Taiwan has implemented many IT constructions and policies in order to reinforce information education in schools. While the Taiwanese people optimistically look forward to a greater learning environment for students in Taiwan, they have also noticed the need for educators to carefully examine the digital divide in the local educational system, as well as how it has influenced children's learning. This research utilised a stratified sampling method. A self-developed questionnaire was conducted on senior students of junior high schools in Taiwan. The findings of this nationwide empirical survey can be summarised as follows: the digital divide, which reflects the socio-economic divide of Taiwan, does occur in Taiwan's educational system; there are gaps between students' information attitude and computer literacy; there is much room for Taiwan to strengthen its information education; and some valid predictors for students' information literacy were detected and can be used to raise students' information literacy.

INTRODUCTION

Research Background

The World Wide Web (WWW) can be accessed anytime and from almost anywhere. Both reaching and spreading information are no longer bound by time constraints and physical limitations. It thus makes possible for people to obtain information in their own flexible schedule at most comers of the world. Nevertheless, users need to get across some thresholds (such as budgets and computer ability) in order to obtain the benefits of this charming information technology (IT). For those who are able to cross such thresholds, both the quantity and quality of the information from the Internet make a big difference in people's digital opportunities, which, it was claimed, would make a great difference on people's personal achievements in the future.

The digital divide is the phenomenon of difference on obtaining information and information literacy due to different personal background and social economic status [1]. Thus, the means to bridge the digital divide include increasing opportunities of contact with IT and strengthening personal competences in IT applications. However, there are those who cannot afford any IT facilities, lack opportunities to access them, or are unable to strengthen their information technology abilities.

In order to provide each student in Taiwan with same opportunity to access information technology, the Ministry of Education (MoE) of Taiwan announced the ten-year long *Information Basic Construction Plan* in 1997 [2]. Moreover, the Executive Yuan made another extension plan in 1998 to push the Taiwan Academic Net (TANet) into Taiwan's elementary and junior high schools. In addition, it is aimed at middle school education, which is the critical period of the development of information literacy [3].

The MoE made the computer course one of the required learning subjects for junior high school students, and also announced the fulfilment of integrating IT into teaching in 1998 [4][5]. They also developed *A Blueprint for Information Technology* to raise teachers' and students' information literacy in the hope to decrease the digital divide by way of providing schools with the necessary IT equipment [6].

Wang noted that education is the key for solving the digital divide. Education is the main bridge that can cross over the digital divide and generate digital chances [7]. However, Chen proposed that the digital divide exists not only in the whole social system, but also in the educational system [8]. As we know, the educational system builds the base of any social development. The main task in solving the problem of the digital divide in the information society is to resolve it in the educational system in advance.

Research Objectives

In line with the trend of information society and the information educational policies proposed by the government, this study targeted junior high students in Taiwan and investigated how their personal attributes and school backgrounds affected their opportunity to access IT and improve their information literacy. The researchers sought to understand the digital divide in the educational system in Taiwan, and provided some suggestions for administrative departments, teachers and parents so as to decrease the digital divide among students in Taiwan.

LITERATURE REVIEW

The Digital Divide in Information Society

The term *digital divide* was first mentioned in a research report of the US Department of Commerce. This report stated that

despite the significant growth in computer ownership and usage overall, this growth has occurred to a greater extent within some income levels, demographic groups and geographic areas than in others [9]. The report also noted that an individual's competence for using IT would determine the quantity of obtaining information, and the quantity of obtaining information would, in turn, decide on the wealth that an individual acquires.

To sum up the viewpoints of scholars, the digital divide is a gap caused by individuals with different socio-economic backgrounds (ie gender, age, race, residence, income, education and language). A person who makes different uses obtains different information, and thus gains different benefits from IT technology. Under the fast development of IT and the permanent nature of personal social economic status, this phenomenon is expected to get even worse.

Bolt suggested that digital technology should be explored with regard to two aspects, as follows:

- *Access*, which concerns the quantity of information gathered from IT;
- *Content*, which covers the quality of information persons get from IT [10].

The Digital Divide in Educational Systems

Many countries take the digital divide seriously and invest much labour and many resources. It is still a maze of suspicion as to whether people in minorities gain any advantage from the thriving IT.

From the relevant literature reviewed, at least three kinds of viewpoints have been proposed, namely:

- *Optimist perspective*: The optimist regards the popularity of IT as being helpful to nations that have fallen behind so that they can catch up with more advanced nations;
- *Pessimist perspective*: The pessimist thinks that the more that IT develops, the greater the digital divide;
- *Embedded (or realist) perspective*: The realist considers that the popularity of IT's influence on a nation or society depends on the original acquired power framework [11].

Wen observed the digital divide phenomenon in the educational system in Taiwan and pointed out major aspects that should be examined [12]. These elements are as follows:

- The gap between students' concepts and attitudes towards computers;
- The divide regarding participating seminars or on-the-job trainings among teachers;
- The gap in schools' technology competences;
- The divide concerning learning circumstances.

Chen further classified these digital divides in the educational system into five features, namely:

- Software and hardware resources;
- Information educational policies;
- Administration organisation;
- Teachers' professional competences;
- Cultural circumstances [13].

METHODOLOGY

Subjects and Sampling

The study focused on senior junior high school students in Taiwan. In order to obtain study subjects, the authors firstly archived relative information of junior high schools around the nation from the Internet site of the MoE, and then divided all of the schools into nine levels in accordance with their level of urbanisation.

Instrument

The instrument of the study is a self-developed questionnaire that includes fours parts. The first part is about IT access, the second is IT content, the third is an *IT literacy scale*, the fourth is *IT attitude scale*, and the last part is about demographic information. The IT literacy scale was classified into five factors, with the Cronbach alpha ranging from 0.797 to 0.810. The factor loadings of the IT attitude scale are all above 0.443, and their Cronbach alpha ranges from 0.718 to 0.803.

Procedure and Statistical Methods

A stratified sampling method was adopted in this study. The authors first sampled the junior high schools in the list provided by the MoE in light of their urbanisation levels, and then divided them into nine levels according to northern, central and southern areas. The questionnaires were mailed to the principals of the schools sampled. The principal of each school then assigned senior students of the first class to fill out the questionnaires. From March to June in 2004, the study received a total of 2,221 returned questionnaires, with 2,143 valid copies. The valid return rate is 63.07%.

Major statistical methods, such as prescriptive statistics, t-test, one-way ANOVA, Pearson product-moment correlations and multiple regression, were conducted in order to analyse the data.

RESULTS AND DISCUSSION

Analysis of the Divide Regarding Access to IT

It was found that 70% of the sample spent less than two hours using the computer and the Internet, while only some of the students spent more than seven hours a day. Most of the students in the sample surfed the Internet at home by way of ADSL. However, there were still 211 samples who had no computer facilities at home, and 369 subjects did not even know how to access the Internet. It was also discovered that most of the classrooms were not equipped with computers (71.8%), and that only 26.6% of classrooms had access to the Internet. Exclusive of the computer class, most of the teachers utilised computers during their teaching, with 90.8% of teachers assigning homework to help students learn how to collect related information on the Internet.

An Analysis of the Divide with Regard to IT Content

Most students utilised computers for the purpose of playing computer games, while only few students used them for compiling programs. Only 2.6% of samples never searched and collected information from the Internet. It was found that the major motivation for the student samples to get on the Internet

was for computer gaming; however, there were still some people who used computers to find musical recordings. It was found that the main purpose in surfing the Internet was for entertainment, while shopping was the least popular choice. Most of the students learned about computers and the Internet from their schoolteachers, with only a few of them participating in the computer cram schools, computer clubs or workshops.

Comparison of IT Access, IT Content, IT Literacy and IT Attitude

Based on the differential comparison on IT access quantity, the findings in this study reveal that subjects from cities of different urbanisation levels have significantly different perceptions about computers in the classroom, computer networks in class, computer class teaching, and teachers' utilisation of computers for teaching ($p<0.001$).

Regarding the gender variable, the only differences found were in the Internet information assignment dimension. Both family income and parents' education variables displayed significant differences concerning classroom computers. Moreover, parents with Internet abilities had a different sense on classroom networking.

As for a comparison of IT content, no matter the level of urbanisation, gender, family income, parents' education, or parents' ability on the Internet, they all show significant differences on the following dimensions: contact experience with the Internet, searching for information on the Internet, learning from important others and using e-mail. Among these, both urbanisation and gender variables displayed differences regarding the motivation for surfing on the Internet as well.

An examination of information attitudes revealed that urbanisation, gender and family income displays significant differences. Parents with different education levels show statistical difference on realness discrimination for the Internet ($p<0.01$), and parents with different Internet abilities perform significantly differently regarding IT awareness and acceptance, interaction with the Internet community, and overall IT attitude dimensions.

Different personal backgrounds, such as urbanisation, family income, parents' education and parents' Internet abilities, show significant differences on all dimensions of IT literacy. In the case of the gender variable, it only displayed statistically significant differences on basic computer operations and overall IT literacy.

The study adopted the statistical method of Pearson's product-moment correlation in order to explore the relationship between junior high students' IT attitudes and their IT literacy. The results indicated that the correlations of all dimensions of IT attitude and IT literacy were very high ($p<0.001$). The correlations between overall IT literacy and overall IT attitude achieved 0.595 ($p<0.001$).

Finally, the researchers wished to understand the valid anticipative factors for IT literacy. The study undertook a stepwise regression method by utilising personal attributes, IT access, IT content and IT attitude as predictors. It revealed, as shown in Table 1, that the most significant predictors with explaining power are interaction with the Internet community, IT awareness and acceptance, the level of contact experience with computers, searching for Internet information, parents' Internet abilities, average time spent using computers, the convenience of school's computers, family income and gender.

CONCLUSION AND SUGGESTIONS

Conclusions

Based on the analysis and discussion given above, the authors have drawn the following major conclusions listed below.

The phenomenon of the digital divide appeared in students' different gender, time spent surfing the Internet, computer experiences, motivation, learning goals and the types of data downloaded. The family played an important role in this too. In addition to family income, parents' educational background and their Internet abilities made a difference too. They all affected students' Internet surfing locations, the avenues of the Internet, IT equipment ownership, the quality of information content, and further reflected in students' IT learning opportunities. As for the factor of the socio-environment, the major digital divide was followed by the difference between the city and the country: so-called *degrees of urbanisation*.

Gaps were detected between students' information attitude and computer literacy. Students' attitudes towards IT were associated with the school's urbanisation level, students' gender, family income and their parents' Internet abilities. Students' IT literacy was also related to the following factors: school's urbanisation level, family income, parents' education and their Internet surfing abilities. Furthermore, students' IT attitudes and IT literacy levels were closely related. In other words, if students have a positive attitude towards IT, then their IT literacy tended to be higher and vice versa, producing a polarity phenomenon.

Table 1: Multiple regression analysis on the influence of IT literacy.

	B	Std. Err	Beta	t	R	R^2	R^2 Change	F Change
Constant	0.876	0.085		10.271				
Interaction with the Internet community	0.258	0.019	0.331	13.777	0.592	0.351	0.351	811.230***
Level of IT awareness and acceptance	0.290	0.021	0.326	13.728	0.652	0.425	0.074	193.801***
Experience of contact with computers	0.080	0.013	0.122	6.284	0.676	0.457	0.032	89.014***
Searching on the Internet for information	0.080	0.014	0.117	5.887	0.688	0.473	0.016	45.867***
Parents' Internet abilities	0.052	0.010	0.103	5.387	0.695	0.483	0.010	29.661***
Average time spent time using computers	0.043	0.011	0.074	3.877	0.700	0.490	0.006	18.217***
Convenience of school's computers	0.076	0.024	0.059	3.221	0.702	0.493	0.004	11.068**
Family income	0.025	0.009	0.052	2.759	0.705	0.497	0.003	9.072**
Gender	0.054	0.024	0.042	2.232	0.706	0.498	0.002	4.981*

*p<0.05; **p<0.01; ***p<0.001

There is room for schools to implement information education that reflects the gap within the socio-economic culture. The convenience of school computers plays an important role in IT education. Commonly, the number of available computers and Internet equipment in classrooms are at insufficient levels. Moreover, most computers in laboratories were utilised only during the computer class. Although there was no significant divide detected on teaching by computers and assigning informational tasks, most students relied heavily on computer related equipment at home to finish homework by way of gleaning Internet resources.

Efforts should be placed on identifying some valid predictors to implement information education and to upgrade students' IT literacy skills. This can be achieved by way of strengthening students' attitudes towards IT, identifying students' individual differences (eg gender and socio-economic status), improving each school's IT environment, promoting parents' IT abilities, and so on. With these efforts, it will surely lead to better performance with regard to promoting students' IT literacy.

Suggestions

The digital divide in education and in the information society should be simultaneously eliminated. This cannot be achieved only by reducing the digital divide in education. The digital divide that exists in the information society also has to be eliminated. As such, the alleviation of the digital divide should be sped up.

Teachers should realise students' backgrounds, their home environments and other relevant factors first, and supply them with adequate and multiple ways of teaching accordingly in an effort to increase their learning motivation. The government and relevant educational units can assist students from minorities to upgrade their IT literacy by supplying them with IT facilities and providing them with earlier opportunities and greater number of channels to come into contact with IT.

In general, most schools have equipped themselves with information facilities under the *Basic Construction Plan for Information Education*, which has already been implemented by the MoE in Taiwan. However, identifying how to make good use of these resources is much more important. School staff and teachers ought to efficiently integrate IT equipment into their administrative work and teaching activities, without letting them idle away. Furthermore, teachers should promote students' Internet surfing skills for information gathering, as well as increase the assignment of IT application homework for students.

Taiwan's government and schools should hold IT related seminars for parents or parents-children workshops. This act could not only promote parents' abilities with regard to computers and the Internet, but would also cooperate with parents' efforts regarding how to help students establish proper IT attitudes and strengthen their IT literacy levels.

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