A Review of the Development of Information Technology and Education: The Role of Culture

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A Review of the Development of Information Technology and Education: The Role of Culture

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Abstract

Many studies have highlighted that IT’s impact on learning outcomes depends on many antecedents. Culture has been identified as one such factor. This paper is a synthesis of three domains – IT, education and culture. It first traces the evolution of IT in education and the relationship between learning theories and IT. Subsequently, the role of culture in the field of IT and education is presented. The paper then proposes that instruction be designed in a culturally sensitive manner. Second, understandings of culture should be allowed to grow in conjunction with developments in IT and education. We hope that these suggestions would generate more research and insight on the intersection of IT, education and culture.

Keywords: Information Systems, Computers and Education, Educational Technology, Culture

Introduction

Imagine a contemporary classroom setting in any culture, one may envisage a teacher conducting a lesson with a computer and the instructional notes projected onto a screen or a live lecture via video conferencing with an expert teacher. Such is the reality of today’s society that Information Technology (IT), education and culture form an intricate mixture. The importance of IT and education is underscored by its global demand. The education and training sector, fuelled by the knowledge economy, is forecast to become one of the biggest sectors in the world. With its ability to rapidly create relevant courseware and frequently update content, educational technology is spot on in meeting the needs of any organization (Bersin 2005). International Data Corporation estimates that worldwide corporate educational technology revenues will hit US$23.7 billion in 2006 up almost fourfold from US$6.6 billion in 2002 (eMarketer.com 2003). There is also a wealth of research associating IT with learning effectiveness (Kulik and Kulik 1991; Chang and Lim 2005).

Amidst this backdrop, there have been calls for greater study on how IT affects education in Information Systems (IS) literature (Leidner and Jarvenpaa 1995; Alavi and Leidner 2001; Benbunan-Fich 2002). Many studies have highlighted that IT’s impact on learning outcomes depends on many antecedents (Hiltz and Johnson 1990; Leidner and Jarvenpaa 1995; Webster and Hackley 1997; Piccoli et al. 2001; Chang and Lim 2005). In particular, a number of researchers have identified culture as one of these factors (Hiltz and Johnson 1990; Leidner and Jarvenpaa 1995; Chang and Lim 2005). In this global
world, learners of diverse backgrounds interact and collaborate with each other using educational technology. The effectiveness of IT for learning thus depends on how national culture differences are accommodated into educational technology. This paper will trace the developments in educational technology and the relationship between learning theories and IT. Subsequently, the paper will focus on the role that national culture plays in the field of IT and education. Lastly, future directions to enrich the field will be put forward. Hopefully, this review will shed light on the nexus between IT, education and culture and contribute to the IS field on the impact of technology on education.

**IT and Education: A Review**

In education, there is a distinct function of educational technology being a tool or equipment vis-à-vis IT as a medium for greater application of knowledge. These are termed technology *in* education and technology *of* education respectively. The former refers to the gadgetry of technology such as instructional media, hardware and software used to present information (Ellington et al. 1993). The latter views the educational system as a whole which encompasses the intangible features from research and learning theories with the hardware and software portions. The technology of education aims to improve the effectiveness of the teaching and learning process (Ellington et al. 1993). We now trace the evolution of IT in education.

**Historical Development of IT in Education**

The progress of IT in education was set in motion when electronic techniques were developed (Taylor and Furnham 2005). Film technology was first utilized in education in World War II when the US military used movies to train its troops (Rosenberg 2001). Soon after, television was used to instruct students. In fact, instructional videos were used as a central part of the US public school’s education in the 1950s and 1960s (Ellington et al. 1993). In the 1980s, scientists developed microcomputers which proliferated into schools (Taylor and Furnham, 2005) enabling individuals to use the computer as a learning tool which was termed computer-aided instruction (CAI). The benefits of CAI include maximizing student learning, providing richer material and offering more accurate evaluations of students (Kulik et al. 1986; Matta and Kern 1989; Tomei 2005). Moreover, the development of programming languages like LOGO enabled individuals to write their own instructional software guided by personal ideas (Adelsberger et al. 2002).

As IT became more widespread and commercially viable, the application of IT in education intensified (Matta and Kern 1989). The Internet explosion in the late 1990s prompted an avalanche of web technologies such as computer-mediated communications (CMC), virtual tours, webblogging, podcasting, virtual reality games for education. The generic term for these learning systems is e-learning. E-learning can be seen as the latest extension of technology in education and includes earlier computer based technologies. E-learning is a big tent that contains the entities of learning, information support and coaching, knowledge management, interaction and collaboration, and guidance and tracking (Rossett 2002). Not solely an interaction between the student and the system, a highly embraced strength of e-learning is that it allows communication between peers and instructors and even collaborative learning communities. Learners are able to share and
interact with other learners; learners can be coached and supported by instructors; and instructors design and utilize the content of the system (Shale and Garrison 1990).

In addition, educational technology is being used simultaneously with traditional classroom teaching to supplement learning. A survey by Kim et al. (2005) found that close to 60% of respondents have gone through mixed mode learning. Moreover, respondents predicted that this delivery method would become prevalent in their organization in the next few years, followed by self-paced e-learning, instructor-led classroom learning, and multimedia. Thus, the current trend is one of convergence where there is a combination of web-based technologies and traditional classroom structures. In fact, this convergence has been coined blended learning by practitioners. Blended learning is the trend of education today. It is practiced in many educational institutes and corporations (Welsh et al. 2003).

As educational technology developed over time, the goals in using IT changed too. Initially, researchers focused on developing discrete knowledge and basic skills of e-learners through drill-and-practice applications of computers (Stites 2004). In later developments, researchers saw the potential for IT to facilitate higher-order learning, problem solving, creativity, and integrated skills development (Stites 2004). Educators and developers have realized the advantage of using technology as a learning strategy based on learning goals (Schunk 2004). Thus the technology of education is now the focus where the goal is to improve learning and teaching based on pedagogy, also known as learning theories or models.

Learning Theories and IT
Learning theories ground structures of the educational systems in almost all countries. Three influential theories of learning have arisen - behaviorism, cognitivism and constructivism. Behaviorism is the traditional learning model that focuses on the observable aspects of the environment on learning (Tomei 2005). The central tenant is that target behavior can be learnt or enforced through repetition and correction. Core principles are the need for objectives, learning through activity and reinforcement through rewards or punishments (Taylor and Furnham 2005). Education is a process of knowledge transfer from the expert teacher to the novice student. CAI is highly suitable for this model. It provides drill and practice programs that reinforce lessons for students, simulation activities for them to improve their decision-making or problem-solving skills and tutorials to teach new subject materials (Tomei 2005). CAI is able to command learners’ attention, provide immediate feedback and improve their learning (Schunk 2004).

While behaviorism concentrates on external stimuli, cognitivism stresses on the internal mental processes of learning (Boettcher and Conrad 2004). Learning involves a change in the cognitive structures of the mind (Strijbos et al. 2004) and occurs when informational input is received and processed (Tomei 2005; Boettcher and Conrad 2004). Cognitivism holds that students learn better through linking prior knowledge, relationships between concepts, well-categorized materials, feedback, catering to the students’ learning style and the engagement of many perceptions as possible (Taylor and Furnham 2005; Leidner
and Jarvenpaa 1995). Technology supports cognitivism when programs imitate the way the brain thinks, i.e., cognitive development through the layout, presentation, sequencing, and delivery of new knowledge (Tomei 2005). Programs also proceed deductively from the general to the specific.

Constructivism is the dominant pedagogy of today (Morphew 2002) where learning is perceived from the locus of learners rather than educators (Tomei 2005). Learning is an experiential process which is constructed by the individual. The teacher is a facilitator who guides the student in making connections between his existing knowledge and the new information. Collaborative Learning Theory is a branch of constructivism. It extends the interaction of the learner with objects, to the interaction of the learner with other individuals (Leidner and Jarvenpaa 1995). The Internet, hypermedia and digital libraries support constructivism (Tomei 2005). Through chats and group support systems, a learning climate that is challenging, understanding, supportive, exciting and free from threat can be created which will facilitate collaborative learning.

Learning theories provide sound principles to effectively teach and increase the learning of students. Combining the strengths of learning theories and IT is core to the earlier mentioned mindset of the technology of education. In fact, this view is prevalent among educators and instructional designers now. Depending on the type of learning and learning goals, educators are designing educational technology that will enhance learning for learners based on pedagogy.

**The role of culture in IT and education**

Learning theories are important in educational technology but they are not the only reason for learner success. Studies have found that other factors such as ability-grouping, culture, instructor immediacy, relevance of content and perceived medium richness of the technology affect the effectiveness of IT in education (Kulik and Kulik, 1991; Leidner and Jarvenpaa, 1995; Webster and Hackley, 1997; Piccoli, Ahmad and Ives, 2001; Chang and Lim, 2005). However, it is neither viable nor useful to review each factor. Thus, this paper focuses on a key aspect, culture, because of globalization and increasing opportunities for students to cross cultural borders in education. Appreciating the role of culture also allows for “a deeper and more valid understanding of the nature of student learning” (Chen et al. 1999, pp.219).

Culture is considered to exist at the national, regional and organizational levels (Watson et al. 1994). This paper focuses on national culture. While organizational cultures “are a phenomenon per se” as their social systems depend on their members (Hofstede 1991, pp.18), national cultures are relatively more stable. Moreover, indigenous elements of national culture can be recognized by the average individual (Walsham 2002). National culture is defined as “the collective programming of the mind which distinguishes the members of one human group from another” (Hofstede 1980, pp.25). Research on national culture includes the work of Hall (1976) and Hofstede\(^1\) (1980, 1991, 2001). Hall (1976) categorized culture into two dimensions – context (high or low) and time

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1 This paper acknowledges that there are a number of controversial views regarding Hofstede’s cultural dimensions (e.g., McSweeney 2002); but for the purpose of the paper, we briefly mention these cultural dimensions. Space constraints also limit the inclusion of other cultural differences and research.

National cultures affect many aspects in IT and education. Unfortunately, extant research in this topic is sporadic (Wild 1999; Heemskerk et al. 2005). The issues that have been examined in the past include the motivation of students from different cultures (Lim, 2004), how students from divergent cultures use email for learning (Frank et al. 2004), perceived learning of culturally diverse students (Chang and Lim 2005), students from various culture’s comfort with CMC (Smith et al. 2005), and cultural diversity in collaborative learning groups (Lim & Liu 2006). Another development in this area is more prescriptive and concerns the design of instructional material for various cultures (Henderson 1996; Chen et al. 1999; Collis 1999; McLoughlin 1999).

The motivation of students for e-learning is a factor that is affected by national cultures. Lim (2004) studied the online learning motivation of students in Korea and US. By conceptualizing motivation into types, the study revealed that American learners are more motivated in terms of course relevancy, interest, reinforcement and self-efficacy than Korean learners. In contrast, Korean learners were more motivated in terms of learner control. The paper finds that learners from Korea, which has a collectivist culture, are more oriented toward effort attribution and performance goals. In contrast, learners from US, which has an individualistic culture, are geared toward mastery of learning over time and enjoying the learning process (Lim 2004).

The usage of email is also a culture dependent determinant of online education effectiveness. Frank et al. (2004) examined the email use of students from Fiji and Australia. Fijians were more likely to use email to socialize with their peers rather than the lecturers. This is to do with the one way teaching model that is the cultural norm there. Conversely, students from Australia, who are relatively more individualistic and have a lower power distance than the students from Fiji, sent more emails to both peers and lecturers. The researchers suggest that distance learning courses should be flexible to accommodate the different usage of email in various national cultures even when all learners have equal access to email.

Culture plays a moderating role in affecting the effectiveness of learning with IT. Chang and Lim’s (2005) meta-analysis of 68 studies from 1990 to 2002 revealed that western cultures had higher self-reported learning and self-efficacy than eastern cultures. They contend that the higher perceived learning is due to the “tendency of western cultures to value individualism, personal achievement, and human interactions that are functionally based” as compared to eastern cultures who tend to prefer “group cooperation and affective expression” (Chang and Lim 2005, p.20).

The design of instruction for multiple cultures is another research stream in IT and education (e.g. Henderson 1996; Chen et al. 1999; Collis 1999; McLoughlin 1999). Collis (1999) studied virtual learning environments in relation to culture. Collis (1999) argued
that the acceptance, use and impact of learning technologies are affected by culture. Dimensions that are sensitive to cultural-related differences include group size, member proximity, task type in relation to IS that supports group collaboration; language and visual appearance of user interfaces; and expectations of the responsibility of learners, instructors, and perception of teaching styles and student behavior. Additionally, Collis proposed that virtual learning systems should be designed for flexibility. The research subsequently described such a system that was implemented for the virtual learning environment in the University of Twente in The Netherlands.

Lastly, instruction can also be designed for different cultures by considering socio-technical dimensions that affect website design. McLoughlin (1999)’s studies with Aborigines at the Edith Cowan University in Perth led the researcher to a process of instructional design that considers the “socio-cultural background and learning styles” (pp.241) of cultures and that is responsive to cultural groups. The research has identified a group of dimensions that relate to both social and technical aspects of education such as the communication styles, information desired and required for presentations, understanding of task sharing and context, control over environment, and the degree of relationship or task focus. In all, the research presented shows that culture affects the acceptance, use, evaluation and design of IT in education. Research on culture is still in its infancy; more work needs to be done to examine its impact with regard to IT and education. The next section elucidates directions for future research.

**Looking Ahead**

Based on the above review, this paper surmises two crucial issues for the future development of the role of culture in IT and education – cultural sensitivity in instructional design and growth in the understanding of culture.

**Cultural sensitivity in the design of instruction**

Cultural sensitivity is often taken for granted in instructional design (Henderson, 1996). Instructional design should be meaningful to students in order to motivate them and help in their learning (McLoughlin, 1999; Heemskerk et al., 2005). Narrow, restricted or stereotypical presentations of different cultures and ethnicities in instructional design and rigidity in instructional structures that do not cater to diverse learning styles impede student’s learning (Heemskerk et al., 2005). Students might lack the cultural context to understand it and become confused and alienated. Therefore, educators and instructional designers need to be aware of cultural differences between themselves and the students and among the students.

In this regard, we echo the views of previous research which highlight various dimensions and provide guidelines as to how instructional material can be designed to be culturally-sensitive (Collis 1999; McLoughlin 1999). However, this paper departs from these earlier views with regard to the implementation. This paper adapts Heemskerk et al.’s (2005) index of inclusiveness of educational tools to highlight three facets and the related sensitivities in which instructional design can be designed with cultural sensitivity. The three facets are - content, interface and instructional structure.
Content is the information that the educational technology provides for the learner. Content can be designed to be culturally sensitive by including the presence of different cultures, representation of cultures, contributions of cultures, authentic context of cultures, being respectful of cultural values, and addressing interests of various cultures. Secondly, interface refers to the visual and audio structure or architecture of educational technology. There should be visual presence and representations of different groups; colors, icons, pictures of animals and other images should be respectful of cultural values. In terms of audio aspects, instructional design should include the use of different voices and different cultural music/sounds.

Third, instructional structure “is the extent to which the way the learning process is structured by the program, or the kind of learning processes that are facilitated by it, fits in with the levels and learning approaches of different groups of students” (Heemskerk et al. 2005, pp.7). Instructional structure can be designed to be more culturally sensitive if they: account for prior knowledge; design and explain thoroughly so that all users can work with it, regardless of differences in IT skills and knowledge, content knowledge and learning capabilities; acknowledge a variety of home languages; provide multiple learning strategies; and offer learning activities for collaboration, communication and different skills.

It would be interesting to discover how culturally diverse learners relate and connect with instructional design to enhance their learning. More specifically, can educational technology be made more respectful and sensitive to learners of different cultures in terms of content, interface or instructional structure? Through considering these facets, instructors can reduce cross-cultural misunderstandings and create a better learning environment for students. The goal is that learners of different cultures can effectively learn from this culturally-sensitive designed instruction.

Growth in cultural understanding in conjunction with the development of IT and education

Earlier we traced the development of IT in education which shows the resiliency and innovativeness of educational technology. As IT matures, so does the use of IT in education. Similarly, this paper proposes that there should be a parallel growth in cultural understandings alongside the development of IT and education. Researchers, educators, and instructors should be open and flexible in understanding culture’s role in IT and education which will change due to the development of IT and education. Akin to the amoeba metaphor (Gunawardena et al. 2003), the growth of the understanding of cultures is “mobile without a definite shape yet maintains its structure” (Gunawardena et al. 2003, pp.769). There are certain overall structures in culture’s role in IT and education – human and design aspects (Picolli et al. 2001). The review has identified both human (e.g. motivation of students and usage of technology) and design aspects (e.g. socio-technical dimensions) in literature. These characteristics are not exhaustive; researchers could consider the impact of other factors relating to culture’s role in IT and education.

In contrast to these relatively fixed structures or categories, the environment around them varies and changes due to the developments in IT and education. There is a dynamic and
interplaying relationship between national culture and educational technology. For instance, the interaction of learners from different national cultures and educational technology will produce new understandings of how educational technology can be effective. Greater efforts are then called for in the form of experimentation and empirical research to examine the nexus among IT, education and culture. Specifically, the impact of national cultures on emerging educational technologies like webblogging and virtual reality games as well as new forms of educational systems like blended learning can be further investigated. This will lead to new cultural understandings which should grow in parallel with the development of educational technology.

**Conclusion**

Information technology’s capacity to support the education of students from different cultures is increasingly being depended upon due to globalization and the expansion of distance education. Moreover, the Internet enables instructors to provide quality instruction to remote students and cater to students of diverse learning styles, different languages and cultures. The aspect of culture is thus important in IT and education today. The review has delineated developments in educational technology and the relationship between learning theories and IT. Subsequently we focus on the role of national culture in the field of IT and education. This paper then proposes that instructors be culturally sensitive in their design of educational materials in terms of the content, interface and instructional structure. Second, understandings of culture should be allowed to grow in conjunction with developments in IT and education. We hope that these suggestions would generate more research and insight on the intersection of IT, education and culture.

**References**


References have been omitted due to space limitations. Readers are welcome to contact the first author for the full list of references by email.
A Resource-Based Model of IT Usage in Shanghai Higher Education Institutions

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Abstract
On the basis of resource-based view, this paper analyzes the impacts of IT resource on different levels of IT usage in Shanghai higher education institutions. By analyzing the survey data from 40 Shanghai institutions, the study contributes several insights to China-context IT usage research and practice in higher education system. First of all, this study sheds lights on the impacts of IT resource on deep IT usage in Shanghai higher education system. Second, the findings suggest that organizational support has significant positive impact on higher education institutions’ managerial IT usage. The study is the first few attempts to explore the process model of IT usage in China higher education institutions.

Keywords: resource-based view, higher education institution, IT usage

1. Introduction
With the fast development of information communication technologies, campus computing construction has become the common trend in higher education institutions. With rapid increase of IT investment, IT usage in higher education institutions in china is advancing in a leap frog way.

With increasing IT investment, more higher education institutions have been attaching increasing importance to the return on investment of campus networks. Since higher education institutions do not have business value, its return on investment can not be calculated by economic payoffs directly. An alternative approach is to evaluate the work efficiencies in education, research and administrative management activities that are improved by IT.

2. Literature Review
While previous IS research focused most on IT usage in commercial organizations, little attention were given to not-for-profit organizations (Chiassion and Davidson 2005), like education institutions and non-profit third-party consortiums. In this study, we analyzed the IT adoption process, from IT investment to different levels of IT usage, in education institutions that are of a typical type of not-for-profit organization.

2.1. Resource Based View (RBV)
In IT context, RBV can be used to understand the link between IT resource and competitive advantages. IT-related resources are defined and categorized diversely.
(Mata et al. 1995) defined four types of IT resources: capital, proprietary technology, technical IT skills and managerial IT skills, in which the managerial skill is empirically proved to be sustainable. (Powell et al. 1997) divided IT resources into human resources, business resources, and technology resources. (Melville et al. 2004) described two types of IT resources: technological IT resource and human IT resource. Complementary organizational resources also plays an important role in IT business value generation (Melville et al. 2004). The resources include non-IT physical resources, non-IT human resources and organizational resources (Barney 1991).

In this study, three widely-used resource types are investigated: financial resource, technological resource and organizational resource.

2.2. China Informatization and Her Higher Education Institutions

The nationwide IT adoption phase is called the informatization process in China and keeps speeding up in the decade. Among all provinces and big cities, Shanghai ranks number one in information resource, IT infrastructure and IT application, with a 33% growth rate of her informatization level (ISIC 2004).

As one of the most internationalized region in China, Shanghai higher education institutions face more pressure from global competition. So far, the strategic importance of IT usage in higher education institutions is commonly recognized by higher education institutions. However, after significant investment in IT in years, the institutions now desire a better understanding on the critical factors that may influence the IT output.

3. The Research Model and Hypotheses

With theoretical support by the RBV, we developed a research model shown in Figure 1. Schewe (1976) introduced two forms of use: general use of “routinely generated computer reports” and specific use of “personally initiated requests for additional information not ordinarily in routine reports.” We categorize IT usage into basic usage and advanced usage. Advanced usage includes IT usage in teaching & research activities (Teaching & Research Usage) and management works (management Usage).

![Figure 1: Research Model](image)

Financial investment support will promise higher education institutions to improve and maintain their IT equipments, networks and software applications. Consequently,
Financial Investment Support (FIS) will help higher education institutions to build a better IT infrastructure (ITI) and to enable a greater usage. Therefore we propose:

**H1**: Higher education institutions’ Financial Investment Support positively affects Higher education institutions’ IT infrastructure.

IT infrastructure and application systems are both technological resources for higher education institutions. IT infrastructure includes hardware, campus network, etc. Application systems are various kinds of software that support higher education institutions’ teaching, research activities and management work. With appropriate IT infrastructure, application systems construction can be guaranteed. Therefore we propose:

**H2**: Higher education institutions’ IT infrastructure positively affects higher education institutions’ application Systems.

Basic usage can be available only when essential hardware and network environment have been configured. IT infrastructure provides administrative staffs, teachers and students PCs, campus smart cards, and networks to facilitate their work and study. With appropriate IT infrastructure, the basic requirements of IT usage can be met. Therefore we propose:

**H3**: Higher education institutions’ IT infrastructure positively affects higher education institutions’ basic usage.

Most of managerial IT users are administrative staffs, when using application systems, they need technical support and maintenance service, IT departments can be the professional providers. Organizational support is the strongly backup force for application systems usage. What’s more, organizational support determines whether IS construction can firmly and healthily go on. Therefore we propose:

**H4**: Higher education institutions’ Organizational Support positively affects higher education institutions’ Managerial IT Usage.

Application systems in higher education institutions are mainly the information platforms that support higher education institutions’ teaching, research activities and management work. Research shows that IT resources, including infrastructure and application systems, play a significant role in IT adoption (Cooper et al. 1990). IT usage in higher education institutions can be categorized into basic usage, IT usage in teaching& research activities and managerial IT usage. Therefore we propose:

**H5a**: Higher education institutions’ Application Systems positively affects higher education institutions’ Basic Usage.

**H5b**: Higher education institutions’ Application Systems positively affects higher education institutions’ IT usage in teaching& research activities.

**H5c**: Higher education institutions’ Application Systems positively affects higher education institutions’ Managerial Usage.

Basic usage and advanced usage are two levels of IT usage in higher education institutions. On the first stage of the construction of IT infrastructure, only basic usage can be met in higher education institutions, on the second stage of the construction of application systems, IT usage in teaching& research activities, managerial IT usage can be available. For teachers, researchers, administrative staffs, basic usage enables them to be familiar with IT usage methods and make good use of it. With the knowledge of basic skills, advanced usage can be easier, basic usage facilitates advanced usage. Therefore we propose:
H6a: Higher education institutions’ Basic Usage positively affects higher education institutions’ IT Usage in teaching & research activities.
H6b: Higher education institutions’ Basic Usage positively affects higher education institutions’ Managerial Usage.

4. Methodology

4.1 Data and Method

A questionnaire survey method was used in the study. The survey was organized by Shanghai Educational Association in 2003, a set of large coastal higher education institutions assisted Shanghai Educational Association in the preparation and eventual conduct of the questionnaire survey. During the designing process of the questionnaire, they used literature study, questionnaire investigation and expert interviews methods.

There are 58 higher education institutions in Shanghai according to the data from Shanghai Educational Association issued in 2005. 40 questionnaires were returned and valid. Those institutions are categorized into two types: university and others.

Characteristics of the sample are shown in Table 1.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Full #</th>
<th>% of sample rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>others</td>
<td>14</td>
<td>29</td>
</tr>
<tr>
<td>Total Number</td>
<td>40</td>
<td>58</td>
</tr>
</tbody>
</table>

Table 1: Sample Characteristics. Sample #: the number of questionnaires returned, Full #: the number of institutions there were in Shanghai.

We used partial least squares (PLS) approach (Haenlein et al. 2004; Lohmoller 1989) to examine the model and hypotheses. The sample size requirement of PLS is either 10 times of the largest measurement number within the same construct or 10 times of the largest construct number affecting the same construct (Chin et al. 1999). Our sample size in the study is qualified to satisfy the criteria. The software we used was PLS-Graph.

4.2 Measures and Validity

Most of the constructs in the study were measures adapted from research literatures. Others were final discussion result from professionals in higher education institutions. The items for measuring the constructs were obtained after careful discussion among professionals and validated in pretest.

As shown in Table 2, the composite reliability values for the constructs in the model were all above the suggested threshold of 0.7 (Chin 1998; Straub 1989) except the Teaching & Research Usage construct (with the composite reliability of 0.67) and thus mostly supported the reliability of the measures.

<table>
<thead>
<tr>
<th>Construct and Items</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Investment Support (Composite Reliability = 0.81, AVE = 0.69)</td>
<td></td>
</tr>
<tr>
<td>Yearly financial support in IT construction (FIS1)</td>
<td>0.96</td>
</tr>
<tr>
<td>Yearly financial support in IT operation and maintenance (FIS2)</td>
<td>0.68</td>
</tr>
<tr>
<td>IT Infrastructure (Composite Reliability = 0.88, AVE = 0.71)</td>
<td></td>
</tr>
<tr>
<td>Number of PCs (ITI1)</td>
<td>0.92</td>
</tr>
<tr>
<td>Have campus smart card or not (ITI2)</td>
<td>0.65</td>
</tr>
<tr>
<td>Number of network covering points (ITI3)</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Table 2: Reliability, average variance extracted of Construct and its measures’ loading (\(p<0.01\))

As shown in Table 2, the shared variance between two constructs was less than the root of AVEs in Table 2. Thus, the discriminant validity was supported.

### 5. Data Analysis

The result of the structural model is shown in Figure 2. Most of the hypothesized paths were found significant (\(p<0.01\)). For example, the path coefficient from financial investment support to IT infrastructure is 0.684, from IT infrastructure to application systems is 0.652, and from application systems to managerial IT usage is 0.563. These positive and significant results show a clear map of how IT investment, after an appropriate infrastructure and application systems, finally influences higher education institutions’ managerial IT Usage.
6. Discussion and Conclusions

To study the influences of IT resources on IT usage in Shanghai higher education institutions, we developed a research model and examined the model with empirical data from 40 Shanghai higher education institutions. The empirical analysis reveals several major findings.

Finding 1: It is the basic usage, not application systems, plays an important role to support higher education institutions’ teaching& research activities.

The users of teaching& research systems are professors whose jobs are to teach students and do researches. IT basic usage helps them do their teaching and research work well. On the other hand, application systems do not significantly influence IT usage in teaching& research activities. One reason may be the characteristics of the professors who are knowledge workers in the institution. To them, a flexible working style with basic information support, rather than comprehensive and standardized systems, is critical to their work. The other reason may be that the application systems can not support the teaching and research process.

Finding 2: Managerial IT usage has close relationship with application systems used in various departments of the higher education institutions. To improve management efficiency, corresponding application systems are needed, rather than basic IT usage service.

The result clearly proves the importance of those application systems, higher education institutions should gradually strengthen the construction of them. Basic usage has not influenced managerial IT usage so much as we hypothesized. Therefore when network resources are scarce, higher education institutions should not firstly allocate administrative staffs enough resources, instead, taking teachers, researchers and students into consideration first.

Finding 3: Organizational resource has significant and positive impacts on higher education institutions’ managerial IT usage.

To really improve management efficiency, adequate technical support and maintenance staffs are powerful backup force. The result clearly proves the importance of organizational factors. Therefore, higher education institutions should shift more
attention to improving firm’s organization structure and policies, encouraging the non-technical human training and competence of managerial IT usage.

With careful theoretical development and large empirical data examination, this paper contributes to China higher education institutions context research and practice. First of all, the study applies RBV theory into educational institutions. Second, the study investigates the impacts of IT resource on different levels of IT usage in higher education institutions. Finally, the model provides a useful theoretical guide to understand the informatization process in Shanghai higher education institutions.

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