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Diffusion of ICT in Education: Behavior Subjects, Dynamic Diffusion Model and Enhance Methods

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Abstract: This study examines the dynamic mechanic in the diffusion process of ICT in education. In this paper, the author analyzes the features of three participants (Innovators, Change Agents and Adopters) in the diffusion process of ICT in Education. The Innovators can also be divided into three types: Primary Innovators without market willingness, Flexible Innovators for special demand, and Integrated Innovators towards the marketplace. Early adopters have strong effect with other's potential adopters. Although there are many literates on adoption mode, little research is based on motivation analysis. In this paper, the author tries to bring forward a Dynamic Diffusion Model of ICT in education in order to explain the internal dynamic rules among these behavior subjects. In the end, we also discuss how to promote the internal forces in the diffusion process.

Keywords: Educational Technology, Diffusion, Dynamic Mechanism

1. Introduction

In this current age of rapid technological change, human beings are more than ever paying attention to education and learning in order to individual empowerment, cultural prosperity, social cohesion and economic development. ICT's main application in the past generation has been to raise productivity in the business sector by making it possible for workers and managers to access and process massive amounts of information. (Martin Carnoy, 2004)

As an important marketplace, more and more equipment and software have been made and be sold into schools. The industry declares it has the revolutionary effect of ICT in education. In the university sector, ICT has already made an important impact, whether in terms of teaching, research or administration. However, in the case of ICT in education, education managers are largely illiterate in information management tools. Likewise, despite schools having more and more access to ICT, new technologies are still scarcely used as part of the teaching methodology. There are few real examples with educational models that are based on this technology.

In order to address and cope with these challenges, schools continue to experiment with a variety of programs. As a result, many sophisticated and innovative change models have been implemented in schools. Some models, for example, aimed at bringing about positive changes in schools through improving teacher professional knowledge base and teaching repertoires. Other models focused on developing the capacities of local leadership. Still others attempted to develop innovative curricula for school change or to change the organizational structures and cultures in schools. As

different as these change models are, however, the success of any model depends on the motivation and capacities of the key agents who play a leading role in implementing school change. (Leithwood et al., 2004)

Research on the implementation and institutionalization of educational technology innovation is regarded as "the last mile", which determines the success or failure of research in practice. (Xudong Zheng, 2005) Recent theories and literatures can help to explain where, why and which technologies in education are adopted or rejected. (Holloway, R. E., 1997) However, we still don't know whether there is clear and stable dynamic mechanism. What are the characteristics of the technology diffusion system? How we can further enhance our dynamic mechanism? This article will focus on these issues.

2. Behavior Subjects in the Diffusion of Educational Technology

Diffusion is defined as the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system. The four main elements are the innovation, communication channels, time, and the social system. (Rogers, E. M., 2003) However, additional complexity is added to the use of ICT in education by other external factors which may be technological, social, political, economic or psychological.

The successful diffusion should be both meeting the requirements of education and to covering certain range of schools. Some diffusion needs the drive of intermediary organizations, while others do not. Therefore, there are three subjects in the diffusion process, which are innovators, adopters and change agents. (see Figure 1) Change agents are those who introduce innovations into a society or organization.

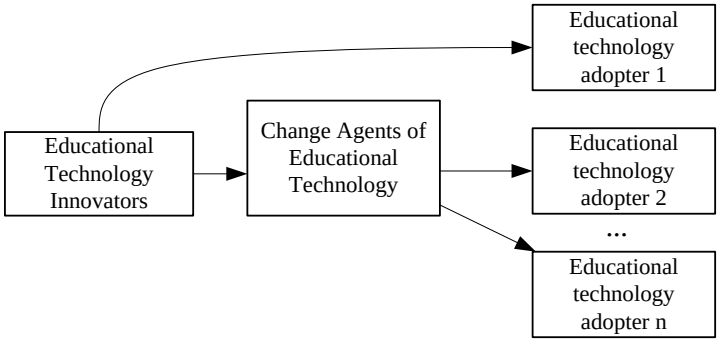

Figure 1. Behavior Subjects in the Diffusion Process of Educational Technology

2.1 Innovators of Educational Technology

Academic organizations mostly play the role of innovators in the system of the diffusion. The innovators of educational technology can be divided into three types:

(1)Primary innovators without market willingness. They are unable to package the concepts and products of educational technology in a market-oriented way, more is to achieve the introduction of integrated innovation or innovative work. The majority of majority of domestic research institutions of educational technology belong to that category;

(2)Flexible Innovators for special demand. They have the ability to put the products of educational technology they create or develop within the field of production, but the scale is often subject to certain restrictions. Most of them use the income of outcome transformation to continuously support the follow-up research activities, which is also called "market-supported research." In the

present case, there is a larger proportion of these organizations, some of which are successful academic teams of educational technology.

(3)Integrated Innovators towards the marketplace. They can both research and develop innovative educational technology products and have a strong external impact. In many cases, the innovation of educational technology first serves for its own needs, and at some point such kind of innovation is exported. This constitutes a very small proportion of academic organizations.

2.2 Adopters of Educational Technology

Schools and teachers are the main adopters of innovation. In China, since the 1990's, the top five pilot ICT in education projects are found that early adoption brings pressures to the similar district or schools, although sometimes the effect to the school's core business growth is not obviously, as long as the involved together with other schools will be able to share the potential "benefits" which are forcing many schools to actively participate. It is financial support by the central government that solves the funding issues to special schools those who cannot afford to. To some extent, that forces the urban schools should by themselves raise funds in different ways in order to improve the equipment, resources, and applications of educational technology, and etc. In addition, many successful adopters of educational technology (especially schools) were analyzed. It will undoubtedly be known: In some schools, the active innovation and the risk-taking spirit in applying educational technology, is largely because it can bring good students, good teachers and effective.

2.3 Change agents of the Diffusion of Educational Technology

During the last four decades, educational researchers and practitioners have intensively engaged in bringing about positive changes in schools. Therefore, the kinds of changes introduced to schools have become complex in nature and overwhelming in number. A large number of external agents — variously referred to as consultants, linking agents, education officers, or supervisors — have mobilized themselves for building schools' capacity and knowledge utilization at the local level. (Mir Afzal Tajik, 2008)

Change agents' role has been defined and described in variety's ways in the literature. Sometimes, their role is captured through the official job titles given to change agents; sometimes, it is portrayed through the strategic actions they take in schools; sometimes it is illustrated through descriptions of their political location and status in schools. The status of the diffusion intermediaries (diffusion facilitators, or change agents) are very obvious in the whole diffusion, because they can help to transmit information, facilitate the contact and communication between innovators and adopters, to assist the negotiations for the final transaction, and to achieve the transfer of outcomes of technology innovation. Evidence shows that most external change agents in the developed nations take on the specific roles such as process helper, resource linker, mediator, knowledge builder, capacity builder, practitioner, innovator, provocateur, and catalyst. (Leithwood, K., et al., 2004)

School reform is extremely complex for K12, due to the limitation of the national support, social awareness and other factors. So educational organizations do not have the drive and features of actively looking for change. Therefore, the position of diffusion change agents are extremely important in the diffusion process. Education usually is unable to make flexible changes. Thus, it is quite necessary and reasonable to take inter-transferring subjects as the important driving force.

3. Dynamic Diffusion Model of ICT in Education

Adoption is the process of finding the right tool for the job. It is one of the oldest and most important concepts in the diffusion-of-innovations (DOI) literature. (Eveland, J. D, 1979) It has been the focus of a mammoth body of research. Despite this abundant literature, there is still much about adoption that is poorly understood. In particular, the innovation diffusion literature has largely ignored decision psychology [6], [7] and has treated the causal aspects of adoption as a black box. Brent A. Zenobia et al (2009) lay the foundation for a comprehensive, step-by-step explanation of how events or life experiences cause a consumer's beliefs about a technology to change over time. They give rise to the Motive-Technology-Belief (MTB) framework, a theory that conceives of technology adoption in terms of three mental structures: motives are inner mental reasons; technologies are tools that pertain to motives; and beliefs are associations between motives and/or technologies. Although the authors believe that agent-based artificial markets are destined to play an important role in the future study of innovation dynamics. But they have no further empirical study of the adoption process that leads to better theory should help artificial markets assume that role.

Based on the above subject of educational technology innovation diffusion analysis, this paper presents a dynamic diffusion model of ICT in education, as shown in Figure 2.

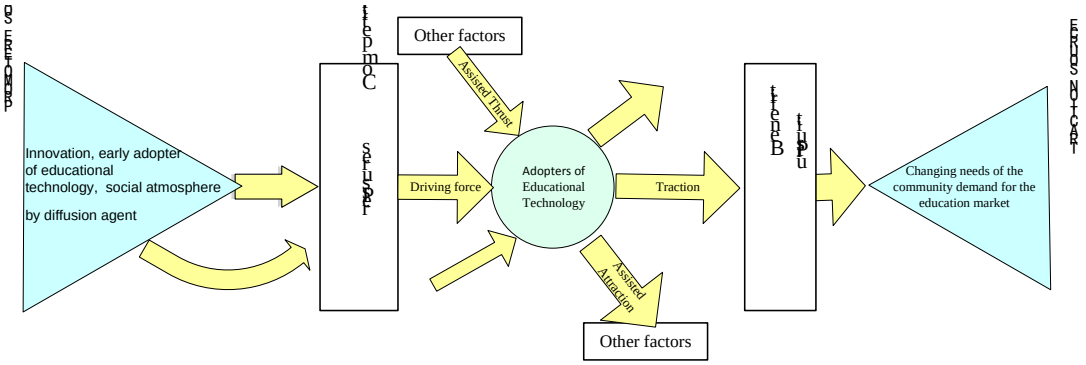

Figure 2. Framework of the Diffusion Power of ICT in Education

3.1 Driving Forces

Academic institutions, enterprises, governmental organizations, or even schools are likely to act as innovators or diffusion intermediary of educational technology, who are promoting the diffusion of educational technology in schools for their own purposes. For all primary and secondary schools, the external environment and atmosphere causes the increasing growth of competitive pressure among schools. They have to conform to the call and request of the government, enhance their competitiveness in cooperation with academic organizations and receive satisfactory service by bargaining with enterprises and so on. The above pressures are the driving forces.

3.2 Adopter' Benefits

Education is the equalizer and the driving force for social development, as well as bearing the responsibility of the transmission of human civilization. The dual responsibility requires education of a better development in the circumstances of effectively solving a variety of problems such as educational, social, cultural,

technological problems. Schools have to continuously improve external relations and internal structures according to the changes of the situation, promote the mutual development of core business and non-core businesses with the adoption of the innovations of educational technology, and achieve the enhancement of the scale and benefits of schools as well as the quality of teachers and students so as to meet the requirements of different aspects. Therefore, to "turn social demands into the demands of the education market" becomes the traction of the diffusion of educational technology in primary and secondary school.

Competitive pressures caused by external environment and early adopters, and the successful adoptions of income by adopters are the main adopters of educational technology. The interaction between the driving force and traction promotes the spread of educational technology innovations.

4. IMPROVING THE DIFFUSION POWER OF EDUCATIONAL TECHNOLOGY

Technology use is contextual and tends to follow, often invisible, ground rules. Within the situational context of education organization the rules and sanctions regarding technology use become increasingly complex. From the perspective of the status quo and reality of diffusion power, there is an enough strong external driving force in the development of educational technology in China, but the main barrier lies in the weakness of internal traction. This paper advises on how to improve the internal power as follows:

4.1 Adopters with the Positive External Guidance

In the process of the national vigorous promotion, the nonfeasance mentality in the educational industry is undesirable. On the one hand, the application of educational technology needs external active promotion and effective support, but the real effects of the application of educational technology need strong internal requirements and active changes. It is the key of the schools to achieve the improvement of educational quality with the recognition of the government, the society, parents and students. If the schools intend to develop highly correlated teaching and learning and improve internal structure and external relations, the positive changes are the fundament of improving the internal development power of schools. The available idea of enhancing internal power may be building the schools as learning organizations.

4.2 Cooperation of Different Driving Forces

In many cases, schools lack available institutional strategies for ICT. Interesting experimentation does not generally lead to successful dissemination and adoption on a wider scale. In many cases, the push for a substantial use of ICT in school programs has come from new educational markets, life-long learning or international education in particular. Inter-institutional and inter-sectoral collaboration between schools and companies are characteristics of many successful ICT initiatives, although they do not generally continue into sustainable implementation in the individual school. (Marijk v. d. W., et al., 1999)

The trend of plenty of cooperation between IT companies and academic organizations makes up for many weaknesses in the promotion of the state to a certain extent. Academic organizations start to cooperate with IT companies or assist the government to promote various projects instead of independently operating pilot projects on the application of educational technology previously, which has become more and more difficult. Recently, the academic-related core parts of most projects rely on some academic organizations and experts, and those projects also become the important object and the main battlefield of the research of academic organizations. At present, the problems in need of urgent

solutions, in reality, are how the governmental organizations, IT companies and academic organizations cooperate with each other and how to improve the application effects of educational technology by selecting appropriate promotional modes and contents, especially how the projects promoted by the government introduce some new mechanisms to ensure the best effects.

4.3 Strengthen In-depth Interactions between Academic Organizations and Schools

The effects of the application of educational technology cannot be simply decided by simple adoption. The effects of the application of educational technology are hierarchal. The costs and values vary at different levels. The level of application is enhanced with the promotion of academic organizations. The most important reasons that cause the obstacles in the application are the lack of detailed analysis of the application in deep levels and the lack of the idea of core value in application. The key to the effects of educational technology is to achieve the transfer and integration of technology.

Academic organizations can give suggestions on realizing the effects of the application of educational technology and give relatively better guidance to educational organizations. Therefore, in the diffusion process, we should vigorously promote the cooperation between academic organizations and schools, which can overcome the tendency of blindness and simplification of the governments or IT companies in the process of promotion.

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