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Diffusion of IT in Childhood Pedagogy
-- extending the RIPPLES model to kindergartens

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ABSTRACT
The trend of utilizing computers in pre-school education will stay regardless of the controversy surrounding childhood pedagogy. This is particularly so for Singapore, a tiny country ranked only second to the United States in information technology (IT) penetration and usage in the latest ranking by the World Economic Forum. How the various stakeholders (government, kindergarten operators, teachers and parents/guardians) shape the styles and methods of IT used should be of utmost concern. This project seeks to understand how computers are being used and how e-learning activities are conducted in Singapore kindergartens. We examine the diffusion and impact in these educational centers through a combination of theory and practice. Surry’s RIPPLES model for overcoming the barriers to integrating instructional technology into higher education is particularly useful. We extend it to kindergartens with the additional “economy” element. The extended model provides valuable feedback to the various stakeholders as well as software vendors.

Keywords
Information technology, diffusion, kindergarten, pre-school, pedagogy, RIPPLES model.

INTRODUCTION
The usage of information technology (IT) in childhood pedagogy has been especially controversial. On one hand, IT brings about benefits such as heightened level of fun and entertainment during learning, creativity and early exposure, but on the other, potential problems like health (deterioration of eyesight, posture problems) and social (addiction, selfishness) risks. This is even more crucial with younger children, since such IT usage is bound to have impacts on their future, and as a result, consequential implications on our society. Even for authors without a clear stand on whether IT usage is more advantageous or disadvantageous in pre-school education, their concern lies in whether such technologies are economically justifiable as pedagogical tools (Healy, 1998). It seems that the general consensus of most is that technology can be quite useful and practical, but not definitely necessary for children before primary school education.

It is very interesting to examine the diffusion and impact of IT usage in Singapore at kindergarten level since there is neither current policy nor research focusing on this aspect. Moreover, kindergartens are the mainstream of pre-schools and are more prevalent in the use of IT in pedagogy. As there are prescribed educational policies on IT usage from the primary to tertiary educational levels by the Ministry of Education (MOE, 1997), one wonders why there are no fixed guidelines on the same subject across the board for the kindergartens (MOE, 2003), the last step prior to primary one level and commonly perceived as the beginning of formal education. It is even more perplexing for a large kindergarten operator with hundreds of centers to operate some of its centers with computer-aided education (CAE) and some centers without.

This project tries to analyze the background, as well as the inhibitors and the facilitators of this scenario. Through empirical findings, we examine how the various stakeholders (government, administrators, teachers, parents/guardians) can shape the styles and methods of IT usage in kindergartens. Finally, we extend Surry’s RIPPLES model (Surry, 2002), originally based on higher education, to apply it to kindergartens. The extended model, with the additional “economy” element which makes it applicable globally, provides valuable feedback to the various stakeholders as well as software vendors.

The authors gratefully acknowledge the assistance of Professor Daniel W. Surry (RIPPLES model creator) of the University of South Alabama for his many helpful suggestions and encouragement.
LITERATURE REVIEW

As in any innovation or technological adoption, the introduction of IT into our local kindergartens for pedagogical purposes sees both supporters and non-supporters. Rogers’ theory of Diffusion of Innovations (Rogers, 1995) guides our understanding about these various groups of users, and segregates their views and perceptions about IT usage for childhood pedagogy. This categorization provides the background on which the relevant policies can be improved, as well as to understand other related issues involved, such as the barriers of adoption (Beggs, 2000), facilitators and inhibitors (Wang and Chan, 1995), and characteristics of attributes that could influence the rate of adoption. Our findings suggest that while there are apparent disadvantages associated with early usage of IT for young children, the network effects and critical mass theory cause the trend in the continued usage of IT in childhood pedagogy. Therefore, instead of trying to conjecture whether IT tools should or should not be employed in kindergartens, we take the more practical approach to look into ways of ensuring the feasibility and success of this usage.

To get a better insight of what other countries are doing about IT in the realm of early childhood education, a number of papers on relevant policies employed in other countries were read. Examples are Scotland (Scottish Executive, 2003; Stephen and Plowman, 2002, 2003), Canada (Alberta, 2004), and the US (NAEYC, 1998; NREL, 2001). There are some key issues identified from these papers, which coincide well with the data collected for this project. This congruence signifies that these issues are important, borderless, and should be given serious consideration. Examples include: the need for adult guidance when children use computers, the benefits of interaction among peers with using computers in pedagogy, training for teachers (KidSource Online, 2001), as well as health risks associated with myopia, posture and antisocial behavior for a growing child.

Surry’s RIPPLES model (2002) and subsequent updates (Surry, Ensminger and Jones, 2003) provide a very structural method of understanding the factors influencing instructional technology on higher education. The name of the model comes from the main elements: Resources, Infrastructure, People, Policies, Learning, Evaluation, and Support. It addresses the barriers to integrating instructional technology into colleges and universities. Although there are significant differences and gaps between higher education and pre-school education, we find that it ties in with the findings of our project, in particular, in identifying the factors that facilitate the integration of IT into childhood pedagogy and the steps stakeholders can take to achieve this goal. In its application to the kindergarten settings, we make suitable modifications as well as propose an extension to the model.

METHODOLOGY

Data Collection

To increase value of this research, and to further the certainty of more theories in mind, empirical data need to be collected by visiting kindergarten centers and interviewing the various stakeholders. With the kind assistance of the kindergarten operators at their operational headquarters, centers for site visits were carefully selected so as to form a representative view for our qualitative analysis while some necessary quantitative information were simply obtained from those available on file from their headquarters’ records. The center selection criteria include the level of technology usage (or non-usage), the teaching styles or cultures (e.g. community foundation, church, clan associations or pure commercial entity) and the location, accessibility and surrounding economy (e.g. upmarket, heartland, business districts etc.). Seven centers were thus selected. The bulk of the selected centers belong to the largest kindergarten operator accounting for about half of Singapore’s total kindergarten enrollment, operating the widest spread geographically with 312 centers. All visits were carried out during their class sessions to facilitate observation and interviews with the various stakeholders. Close observation of the kids’ learning progress while attending computer and/or non-computer based lessons, interactions among themselves and their teachers were recorded. There were between 6 to 10 interviewees per center visited. Respondents in each center were separated into 3 main groups, namely the Principals/Administrators/Administrative Staff, the Teachers and the Children. The first 2 groups were interviewed directly while the children were selectively interviewed but mostly observed as they may be too young to be accounted for their responses. Views from parents/guardians were also recorded to complement their children whenever available. Intense field work, started in May 2003, was completed in August 2003. Additional information gathering, clarifications and follow-up work with the centers and their headquarters continued through phone calls and e-mails even amid compilation of this report.

Of these centers, some are avid supporters and users of technology, a portion sit on the fence, while others are strongly against the use of computers in their kindergartens, for they do not believe that IT can help children in learning at such a tender age. There are also those who support IT usage in childhood pedagogy but do not use them as yet, mostly due to either financial considerations or organizational policies. Specifically, there was also one center which during the interview, was in...
the transition stage of acquiring the necessary hardware for computer lessons. There are also some centers which currently have not experienced using computers for teaching, but would like to try out the process soon.

Altogether 18 open-ended probing questions were used to steer the respondents towards the research question involved, but not to influence their opinions. As conversations were not restricted to pre-drawn topics, upon relevancy in responses, impromptu questions were also frequently asked to solicit further opinions to build up depth in the answers.

Data Analysis (on Site Visits, Interviews and Observations)

Interviews from the site visits of the kindergarten centers were first transcribed on paper, and then compared alongside one another for general trends and mainstream opinions. Certain keywords were repeated in most of the interviews, and from them various propositions, as elaborated below, were built to construct the arguments.

A chart was also drawn up to identify the major pros and cons of IT usage in kindergartens for pedagogy purposes. From there, it was then worked out on whether IT tools should be used, and how they should be used, based on the perceived facilitators and inhibitors of such usage.

MAIN FINDINGS AND ANALYSIS

Categorizing the Various Groups of Users

IT for kindergarten education is relatively a new trend in Singapore. The diffusion curve (Rogers, 1995) shows roughly the segmentation of user groups, namely, ‘Innovators’, ‘Early Adopters’, ‘Early Majority’, ‘Late Majority’ and ‘Laggards’. Our data shows that there are both supporters and non-supporters and there are approximately equal number of ‘Innovators’, ‘Early Adopters’ and ‘Early Majority’ as compared to the ‘Late Majority’ and ‘Laggards’.

Factors affecting these groupings range from price and costs (IT investments and school fees), compatibility with existing teaching system (whether it fits with educators’ beliefs and curriculum) and perceived risks (health, social and ethical) to promotional efforts by related stakeholders (governmental support or parental requests) as well as to a lesser extent, communicability of benefits and ease of use.

The Supporters…

In Singapore, ‘Innovators’ encompass the kindergartens who have used computers in their centers as early as a decade ago. Some were prestige kindergartens which initially adopted computers more for reasons of providing an exclusive service to answer the need for a competitive advantage as they usually charge higher fees and follow a niche marketing approach. One of the centers visited started CAE as early as 1992. An ‘Early Adopter’ interviewed indicated that their movement was to follow the ‘Innovators’ as well as to respond to the government’s call for IT literacy and promotion of e-learning.

These two groups of users generally hold a more affirmative view to IT use in childhood pedagogy. Principals and teachers believe that technology helps children in improving some academic and fine motor skills, as learning can be made more interesting and fun. These centers, conducting between two to four hours of computer lessons per week for each student, encourage parents to continue IT education for their children back at home. They also use IT as reward tools to encourage good behavior in children. For instance, children who submit their homework on time and are well-disciplined may get freedom in choosing whatever games they might want to play during a computer lesson. They also get to choose to surf kid-related sites such as Neopets and Disney.com instead of having to stick with math or phonics software.

Most importantly, whether they are solely supportive of computer usage or mildly swayed to the reasons of non-usage, these and the ‘Early Majority’ are the users who believe that children can be exposed to computers at this age and that the rest of the non-adopters will gradually become adopters like them as well.

The Non-Supporters…

The ‘Late Majority’ and ‘Laggards’ are more conservative or skeptical in their views to children using computers for learning. To them, kindergarten education should be built on a foundation of physical and moral learning activities, like song and dance, or social skills like courtesy, sharing and meal etiquette. They are also mostly strong opponents of even introducing academic-related lessons like language and arithmetic to children below the age of six. To such principals and
teachers, learning at this phase of growth should be on how to become a better person and building on individual potentials, instead of devoting most of the children’s time to scholastic and/or technological subjects.

These users also fear that health risks (posture and eyesight), addiction to computer games and lack of social skills may be the negative implications if they were to introduce computer lessons.

However, the ‘Late Majority’ might be more likely to move onto the bandwagon if usage of computers in kindergartens really becomes pervasive and commonplace. The ‘Laggards’, albeit a small percentage will be the hardest to convince, as they strongly believe in the non-usage of IT for teaching children. From the field studies, such kindergartens are mostly those with a high religious or cultural connotation. These education centers operate with innately different missions from the community or lavish private kindergartens. While the latter’s emphasis is on making money through developing children who can keep up with societal standards, kindergartens operated by religious (e.g. Christian churches or Buddhist temples) or dialect associations place their focus on providing children with people and communication skills.

Children and their Parents/Guardians

All children interviewed mentioned that they enjoy computer lessons, think that computers are fun, and boast about knowing how to startup/shutdown a computer or activate a particular program/game and other such knowledge. Teachers also mentioned that children get excited whenever it is time for computer lessons. One parent indicated that she bought a computer for home use simply because her child loves it. Therefore, computer lessons in kindergartens are feasible when considered on the aspect of reception and acceptance. However, besides the skeptics, all parents and teachers acknowledged that at kindergarten level, IT usage in childhood pedagogy can supplement but not replace teachers’ work. They felt that IT serves different needs from traditional teaching and children also learn more through their peers than through computer usage.

Rate of Diffusion is Slow in Singapore Kindergartens

More than a decade after computer was introduced into kindergartens in Singapore for teaching purposes, the usage is still not as prevalent as expected. During our visits, out of a total of 55 interviewees questioned, 49 feel that for the majority of local kindergartens to adopt some form of computer-based learning in their curricula, it would take at least another 5 to 10 years from today. This is strange because Singapore has always been viewed as a more technologically-advanced and technologically-utopian country, which places much emphasis on IT literacy. However, when looking into the reason at the micro level, affordability (investment cost and school fee structure) plays an important role in this phenomenon. To cater to the “heartlanders” (CDC, 2000), some centers of a kindergarten operator may be CAE-equipped while other centers of the same operator may not. In a CAE-equipped center visited, some children were enrolled in CAE-classes while others are not. More to this and the lack of policy in this area will be discussed below.

DISCUSSION AND RECOMMENDATIONS

The RIPPLES Model

The elements of Surry’s RIPPLES model (Surry, 2002; Surry, Ensminger and Jones, 2003), Resources, Infrastructure, People, Policies, Learning, Evaluation and Support all stem from a solely educational perspective for higher education. Looking into the kindergarten settings, we can make suitable modifications and recommendations to the model to facilitate the IT usage in childhood pedagogy. However, we note that a country’s education and economy always go hand in hand; the more developed and economically healthy a country is perceived as, the higher standards of literacy, IT usage and average educational levels of its people. Going down to the micro level and from our findings as noted above, we shall introduce an additional element – ‘e’conomy to extend the model.

The e-RIPPLES Model and Its Elements

By prefixing an ‘e’ to the RIPPLES model, we formulate an e-RIPPLES model. This ‘e’ shall be taken to mean economy – the community system of wealth creation (Oxford dictionary). This new element should not be just seen as an addition to substantiate the factors governing instructional technology in educational centers, it is also a background upon which the original seven elements of RIPPLES are influenced from and/or will act upon.
**Economy**

The ‘e’conomy element is perhaps most aptly justified by what we commonly know as the digital divide. In certain regions of huge countries like China, India or African states, there are vast differences between the living standards, and consequently educational levels between the rural and cosmopolitan areas. In certain outlaying regions, when hunger or survival is the first and foremost problem to tackle, education (and let alone computer-aided education) seems extremely extraneous. Therefore, we need to first look at the economic status of a region, locality or country before it is suitable to apply the RIPPLES model.

From the literature reviews of IT usage in pedagogy of other countries, it can be seen that most of the countries which have computer based learning for pre-school levels are developed countries like US, Canada or UK. Therefore the general and straightforward inference is that the more economically developed a country, the more advanced it is in the usage. Singapore is ranked 2nd only to the United States by the World Economic Forum in the latest ranking exercise (WEF, 2003) for IT penetration and usage, bypassing many advanced European countries (OUTLAW, 2003; ST3, 2003), with 70% of families here owning a personal computer. Most western countries view Singapore as a developed country, but Singapore proclaims herself as a developing country instead (Asiaweek, 2001). In any case, Singaporeans are generally seen as affluent and enjoys high living standards, and should thus relate to a higher level of IT usage in pre-school education. However, there is still a clear divide on this usage among this rather homogeneous tiny country, termed as a centrally-controlled “nanny state” (Fitzpatrick, 2003). Our site visits and data collected confirm that the difference in economic status of heartlanders (CDC, 2000) and well-to-do cosmopolitans influence the choice of the kindergarten or which center within the same kindergarten, or even CAE or non-CAE classes within the center and therefore, the opportunity for their children to experience IT tools in learning.

All kindergartens in Singapore are operated privately and none of them received public funds. IT investments in kindergartens always relate to the school fees they charged. The economy element surrounds the other elements of the RIPPLES model. The country or region’s economy, the locality of the center within the region where the kindergarten situates and the affordability of the parents affects critically the adoption of IT in their education. Moreover, with limited funding and fiscal resources, allocation and seeking of additional funds should be tuned closely towards the surrounding environment in order to obtain additional support.

**Resources**

There can never be implementation of technology without the necessary finances. Given the fact that IT tools and their maintenance are pricey in Singapore compared to traditional teaching media, it can be deduced that financial resources can itself be a major barrier to uptake of computer usage. Indeed, all respondents of the interviews confirmed the same need and importance for these resources. Thus, the effective use of these limited resources is critical to the success of the utilization. Manpower and Physical resources are covered under the elements ‘People’ and ‘Infrastructure’ below respectively.

**Infrastructure**

For effective learning, it has been observed through the site visits that there should be at least about fifteen to twenty sets of computers in a typical center. This is because majority of kindergarten classes in Singapore have approximately thirty students per class. The ratio of two students to one computer is the most preferred in all kindergartens interviewed. Other than cost savings, this ratio eliminates the possibility of overcrowding, yet retains the social capital of enhanced learning through sharing and cooperation (ST2, 2001) between a peer-partner. This is in contrast to the adult learning environment whereby a one to one ratio seems more ideal.

**People**

The main people involved in this setting includes principals/administrators, teachers and the children. However, unlike higher education, parents/guardians also play a significant role for children of this young age. By understanding the types of interaction between the ‘people’ involved, it will then be easier to tailor policies to encourage these stakeholders to join efforts in promoting the beneficial use of IT. Trust and support within and outside the kindergarten center is an integral part of the education system. Reward systems related to monetary or material terms at this childhood level are not effective. Children love computers and love is the most primitive and most important single factor to be taken into consideration when various systems are expanded and incorporated to motivate children’s learning process.
Policies

In terms of state-level policy, it is surprising that while computer lessons are compulsory for all Singaporean primary schools (ST1, 1996) starting from primary one classes upward with programs such as AITP, STW and JCNet (MOE, 1997), there are no guidelines or policies on IT education or usage whatsoever for kindergarten levels (MOE, 2003), the last prior step to primary school education. Although almost all primary one children in Singapore have had kindergarten education, the government’s frequent push for higher levels of IT literacy through policies such as Infocomm21 (IDA, 2003) and IT masterplan (MOE, 1997) never involve them.

Policies should be developed as a framework for kindergartens such that the usage of IT in each kindergarten continually satisfies pedagogic goals and offers educational value to children. In addition, policies may also shape the future development of such uses. This is in contrast to Surry’s analysis of the ‘Policies’ element on higher education, which regards retention, tenure, and promotion of faculty or certifications/qualifications – all of which hold little relevancy to the kindergarten setting we are examining, since IT at this junior level is used more for exploration and awareness rather than competency and specialization. For a large single kindergarten operator having hundreds of centers like the one in our case study, there is no one single IT-related policy which applies to all its centers. Instead, it appears that policies are sorted according to locality more often than using a common generic one across the board. Even within a center of such a kindergarten, there may be related IT policies pertaining to a range of financial, ethical or administrative issues, there is no guidelines related to the pedagogic use. Individual class teacher make decisions based on their best judgment. This situation must be improved upon especially there is no “IT-trained” requirements for the childhood educators at present.

Learning

Without the learning factor, the use of IT will be redundant in achieving the goals of pedagogy. This is where software vendors need to liaise with kindergarten administrators and teachers to fully understand the curriculum of kindergarten education, so that they can produce suitable software which enhances the value of the children’s education. However, the least that such lessons should achieve is to familiarize and accustom children with technology, and preferably give them a head start before primary school education which is compulsory in Singapore. As of now, all primary schools already have IT-incorporated curriculum under the AITP program (MOE, 1997) which started in mid-1995, and it makes perfect sense that kindergarten children get the opportunity to learn some basic skills with computers.

To a smaller extent, teachers also learn new methods to arouse their students’ interests, and other forms of tacit and documented knowledge as they come across new information and realizations. Uplifting IT proficiency of teachers and trainers becomes critical before compulsory requirements are introduced.

Evaluation

Any form of technological or innovative introduction will not reach its possibly maximum advantage without well-prescribed assessment criteria. Generally, there is a lack of a rigorous system of evaluation of computer based education (Reeves, 1997). This is due to reasons such as the slow development of research in the related area, wrong emphasis that is placed on quantitative data and fallacy of assumption derived from advertisements of the benefits of IT resources. These methods of evaluation are not well-rounded enough to ascertain if technological usage in pedagogy is justified for, especially in a kindergarten setting where computer based education is still a more debatable issue as compared to higher education.

Therefore, kindergartens need to look not only into cost/benefit analysis for economic justification, but also whether technological usage satisfies pedagogical goals such as increased inquisitiveness, more effective learning, prolonged memory or higher attention span, etc. for children. As a result of evaluation on these factors, steps could then be undertaken to correct deficiencies or improve on existing weaknesses to ensure that IT usage brings about more good than harm. Additionally, even policies can then be tuned accordingly.

Support

Various modes of support are necessary to ensure the success of IT usage in kindergartens as a learning tool. Training of the teachers in the usage, simple troubleshooting and teaching methodologies are needed. To a large extent, administrative support should also be present to improve the efficiency and effectiveness of IT usage. Computers for learning by children are still envisaged as not important or time critical. Frequent downs are not taken seriously which frustrated the children who are looking at use of computers as rewards for good work or behavior. An additional type of support relevant to kindergarten
education as opposed to higher education is parental/guardian supports as their role are more significant to children of this young age.

CONCLUSION

Usage of IT in childhood pedagogy in Singapore will continue to progress under its present environment and in other economies. We believe this study provides valuable references for administrators and policy makers who may be looking into the remaining barriers of IT usage in childhood pedagogy. The e-RIPPLES model we formulated, extended from the RIPPLES model for higher education, guides the appropriate and effective use of computers for childhood pedagogy purposes. Carefully considered and adopted in the right perspective, not only will it benefit the various stakeholders but also serve to path the way for all our young children to be well-equipped for their formal education in primary schools in the IT age of today.

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