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科技應用與教學焦點
——新加坡"怕輸"經驗的啓示

Mr Kiasu and IT: Sharpening our focus on technology - enhanced learning

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摘　　要

現代科技日新月異，在這瞬息萬變的世界中，新加坡必須不斷提高其勞動人口的技能，才能維持其競爭力，使其經濟能繼續成長，每一個工作人員必須具備所需之各種知識、技能和正確的態度，俾能獨立思考、學習，幷能迅速而有效地應付工作上面對的各種各樣的難題。

教學與資訊科技，尤其是視聽媒體，能大大地提高資料的檢索和搜集的效率和成果，此外，它也爲知識的傳授開闢了新的途徑，幷使知識傳授者面對新的考驗，這一點，在師資訓練尤其值得重視，這是因爲，師資訓練的最重要的目的之一，是要受訓者能夠在適當的時候，適當地選用那些眞正能提高學習效果的科技，但令人遺憾的是，新加坡很多的學校或教育機構中，科技不是被濫用，就是被忽視，究其原因，主要有兩個：〝怕輸〞和〝怕失敗〞。前者對那些積極求變的教師而言，後者則指保守因循的教師。

本文的目的是探討新加坡教育系統中上述的種種現象，筆者認爲教學界必須趕緊把焦點放在教學科技和資訊科技上，才能趕上時刻在變化的工作和教育需求。爲了能對科技應用有更明晰的概念，教育工作者必須根據最新的教學研究成果，重新剖析認知、學習和教學等行爲。同時，我們也必須檢討我們對學習過程、技能的掌握和應用，以及集體學習等方面的認識，這樣才能訓練出高效率的學習者，從而提高各種工作場所中的學習精神。

新加坡目前正努力在學校及師資訓練的課程中，引進教學及資訊科技。本文會對新加坡的種種嘗試，作一介紹和論述。在新加坡推行的各種計劃中，一個名爲〝SUCCESS〞的計劃，是特別值得一提的一個。所謂

〝SUCCESS〞，是英文〝the Strategic Use of Computer for Constructing Effective StudieS〞這語句的簡稱。這個全稱翻譯成中文，是〝有策略地應用電腦以構造學習成效〞的意思。這個計劃以構造主義爲主導理論，在各個課程中利用電腦，以提高研究對象的學習效果和成績。被選爲研究對象的，是在兩間中學修讀普通課程工藝組的學生（在新坡，一般來說，那些成績最差的學生才會被分派到普通課程工藝組）。在試驗計劃中，一間中學的學生被派去調查消費者在購物時如何作出選擇，然後利用電腦分析數據、展示調查報告。

上述的試驗計劃以及新加坡過去的〝怕輸〞和〝怕失敗〞的經驗，可作爲將來發展教學及資訊科技的借鑒；同時對如何更適當地使用教學科技，以培養出高效能的學習者和提高各工作領域的學習精神，也有其啓示作用。歸納而言，將來發展教學及資訊科技時，我們必須定下一些更實際的目標和範疇，把焦點放在計劃和設計上；教學時以學生爲中心，設計些切合實際而恰當的學習活動，并讓學生有機會在整個學習過程中適當地應用科技。

科技應用與教學焦點
——新加坡〝怕輸〞經驗的啓示

前　言

我要和各位分享身爲教師和學生對教學科技的經驗，這些經驗是在香港、中國大陸、新加坡和美國所體會得到的。　　五十年代末期，六十年代初期，當我還是一個學生的時候，教學主要還是以講述和粉筆爲主。好的老師很會講課，無論是口語表達或面部表情都很生動、豐富。我們當學生的，很會聽也很會抄。六十年代，當我接受師資培育訓練準備當老師的時候，老師教我們要使用圖片、地圖、模型、唱片、錄音帶、幻燈片和電影片。有些〝怕輸〞(1)老師對於有這麼多樣的媒體覺得很興奮—雖然他們經常誤用媒體。但是，大部份的老師所使用的教學方法還是沒有改變。六、七十年代是電視的時代。怕輸先生可能覺得，如果在課堂上沒有把電視和錄影帶加到成堆的媒體當中，那一定會有所缺失。八十年代，市場上的電腦大爲增多，它的名字和透過練習類及教導類軟體可以提高學習效果概念，使得怕輸先生過度的使用電腦語言和數學軟體，但是大部份的老師此時卻覺得被拒在門外。到了九十年代，個人電腦爲資訊所帶來的尋取、擴展和轉換實在太鉅大了。因此美國科學家像皮爾門(Lewis Perelman)等人紛紛宣佈學校和正式教育即將消失。新科技和所謂的超學習系統，可以讓任何人，在任何時間，在任何地點學習任何東西，而且得到像甲這樣的好的成績，這種情形眞是學習的重大改革。新加坡教育部也對國家電腦委員會所領導研發的教育軟體如 師生工作台寄予厚望。不久之後，我們不僅會聽到所謂的示範學校參與這項活動，而且所有先進的教師和校長都會想辦法跟上流行。教學科技--IT 成爲資訊科技的同義詞，同時也隨著其發展而跟著成長。怕輸先生，當然也不希望被科技的潮流所淘汰。

1955 年，隨著國家教學科技二千年的宣佈，每一個在新加坡的教育機

構，包括國立教育研究院，不只是作計畫，並且也推動偉大的計畫。這正是變化快速的九十年代的教師和師範教師的情境，這個時代的口號是：「使用它（IT，教學科技），或成爲它(it)--落伍者」。

許多老師因此不禁要問：「教學科技是否能成爲新加坡經濟成功的保證。」「單單使用電腦能否讓上班族跟得上職場快速變革的腳步？」「通曉教學科技能自動引致其他學科的學習？」「教學科技能否眞正促進高績效的學習群族的形成？」

經驗的分享

帶著社會上對教學科技的興奮心情，我要對媒體和資訊科技對在理解和學習心理學上所扮演的角色提出一些看法。

我們透過看、聽、嚐、聞、觸摸來認識事物。經由感官的直接體驗，讓我們一點一滴地認識人類和環境。我們也從不同的媒體和實做中學習。說實在的，我們從做中學。此種行動使我們獲得新的意義、新的理解或更精進的技巧。認識事物主要透過感官，但學習卻牽涉更複雜的心智歷程，例如記憶、思考和問題解決。

當我們瞭解和傾聽某人的問題、故事和苦惱時，我們就是在教導他（她），雖然並不是直接教導、傳授知識給他（她）。當某人瞭解我們的解釋，並和我們分享他（她）所理解的事物時，我們也是在教導他（她）某事。相互的瞭解是教學的一系列互動的開始，相互的交流使我們產生了更多的認識、學習和瞭解。

認識、學習和教導是很相關的人類活動，他們是互相關連而不是獨立的行動。從我們專業的經驗來看，我們知道科技（不論是過程或結果），可以增進我們對事物的認識、學習和教導。問題是：使用科技學習的腳步，趕不上科技產品、術語和語言的成長。這種現象使教師（甚至於師範教育學者）產生了對科技的焦慮、困惑、誤解和誤用。

我們並不全是用電腦來教導所有的事物，因此也不像皮爾門在哈得遜研究院所提出的「2001年學習方案」中所描述的「超學習，新科技和教育

的終結」⑵的情形。所有的科技都應該聰明而適當的被使用。「如何使用科技？」或如何使用電腦來教學是我們主要關切的焦點。更多的電腦和電腦軟體、課程軟體並不能眞正的促進必要的知識和技能的學習。更多的訓練時數也不能使科技自動應用在工作場所。

教師通常知道如何獲得新工具和使用這些工具的技能，因此問題不在於如何獲得，問題的關鍵是在於如何適切地應用科技。身爲教師的我們常常依賴我們所擁有的工具。我們習慣於用某些方式來使用工具，我們不願意放棄所熟悉的教學和評量的工具與方法。是重新思考「科技可以增進學習」的時候了。這是收藏與拋棄、建設與破壞的時候，也是重建、轉換和創新的時候。

我要依學習心理學上的新發展和科技的發展的觀點，對教學科技的重新定位提出一些建議。首先，讓我們把教學科技當成一個研究和實踐的領域來檢視。

檢視教學科技：觀念、錯誤的觀念和創新

視教學科技爲教學的科技

自從1977年以來，美國教育傳播與科技學會將教學科技定義爲：一種整合人、程序、構想、設備和組織的綜合性歷程，以便能在有目的且嚴謹規畫的學習情境中，分析問題和發展、實施、評估與管理解決這些問題的方法。

根據以上的定義，教學科技的焦點在今天還是適切的，因它強調的是歷程而非結果或設備。教學科技不是如何使用粉筆、講述、電視或電腦，而是如何在「有目的且嚴謹規畫的」學習的過程和結果中，有效的應用科技。爲了確保科技適切且有效地被應用，我們的焦點應該放在開放教學系統的設計、發展、實施、評估和管理原則上，而不是在特殊的工具、機器或某一特定的程序上。

封閉的學習系統嚴格地遵循一系列的步驟，在今天它已經無法彈性應

變快速變遷的時代。因此更偏向於設計、發展和使用開放性系統，而不傾向於植基於行爲學派、刺激-反應、增強理論所發展出來的整齊劃一、線性的教學設計模式和系統。輓近的焦點爲認知-建構學習理論，此等理論試圖導引學習者作有意義、主動的學習和自行解決問題。此種焦點是在學習者、學習的歷程以及能夠增進學校或生活中的學習的各種資源上。

視教學科技爲資訊科技

1987年版的朗文當代英文字典將資訊科技定義爲：「利用電腦和電訊傳播系統收集、儲存、應用、傳輸資訊的科學或行動」。今天，教學科技的焦點在於電腦系統、電訊傳播，以及收集、儲存、應用、傳輸資訊的研究和行動。在此案例中，教學科技的意義是廣泛的，而不僅是教學行爲本身。

教師因此應該將教學科技當成是藉助電腦系統和電訊網路來收集、儲存、應用和傳輸資訊。把教學科技當成資訊科技的適當應用，應該包括電腦系統在教學應用上的設計、發展、實施、評鑑以及管理，而不只是專注於傳輸的程序。教學科技應該注重在理解事物的目的和方法，以及善用電腦和電訊傳播系統來促進教學。這些用途當中，應該充分利用網路和多媒體的功能來抓取、儲存、傳送各種文字、圖形、影像等。

爲了說明起見，讓我來舉一些能幫助認識事物和教學的優良電腦程式。（例如，NIE的教學科學部門所發展的「班級經營」，可幫助瞭解眞正的教室情境和解決問題的技能。另外，Edmark公司開發的「思考事物」，可用以發展美術、語文、數學、音樂、科學等科目的思考技巧，包括記憶、批判思考和創造力等。）

這些程式是根據堅實的認知和教育的教學理論，以及下列設計原則發展而來的。

建構理論在科技促進學習的應用：原則、指引和限制

分析優良的電腦程式，可以明顯的發現，這些教學設計者都遵循兩大

人類發展和智力學派的某些學習和認知原則。

第一群準備原則、符合孩童智力發展階段原則以及有關文化和對學習者的影響的原則等，是從認知-建構的觀點而來，例如，皮亞傑的「認知發展理論」(Piaget, 1926, 1977)，魏考斯基的「近接區域發展」和「高等心智歷程的歷史社會文化理論」(Vygotsky, 1924, 1978)，以及最近萊文學派和柴克林的「情境實際活動」(Lave and Chaiklin, 1993)。第二群原則與高登(Gardner，1983)的「多重智力理論」有關。

皮亞傑以年齡和階段，來表示兒童智力、道德發展與身體、情緒發展的關係。當學習者的認知和身體的發展切合的時候，能學習得最好。因此，對於一個還在具體操作期的兒童而言，學習抽象的觀念，將有困難。視聽媒體幫助兒童使他們的經驗具像化，因此視聽媒體應該用來幫助抽象概念和沒有親身體驗的經驗的學習。布魯納(Bruner, 1966)和戴爾(Dale, 1969)，把皮亞傑的理論轉化成更實際的名詞。他們提出描述中介心理狀態的圖像經驗一詞，以作爲抽象符號經驗和實際行爲經驗之間的橋樑。雖然布魯納和戴爾建議使用視聽媒體來提供圖像經驗，教師還是應該判斷「何時」、「如何」在教室內外使用它。只有在教師瞭解媒體選用的原則、知道可能得到用以實際適切應用教學所需的設備及人力時，他們才有可能正確的作判斷。

魏考斯基認爲，個體發展改變的機制，根源於社會與文化。因此，他在「近接區域發展」理論中提到認識文化事物和符號是社會建構的基礎，語言與思考的發展更是如此。他的追隨者開創了認知學徒、情境學習、錨式教學法、眞實的學習和與科技的群體互動等理論(Brown & Duguid, 1991; Chaiklin & Lave, 1993; McCarthey & McMahon: Bershon; Nelson-Le Gall, 1992; McGrath & Hollingshead, 1994; Johnson & Johnson, 1989; Vygotsky, 1924, 1978)。這些理論對我們在設計、發展和實施學習系統及與科技互動的活動時，都有一些啓示且能提供有價值的指引。

以科技的系統化和整體性的本質爲程序，可以提供爲解決生活中的問題的教學的設計架構。

建構主義及社會建構主義將學習者從一種被動的學習型態轉變爲一種

較主動的問題解決型態；從單一觀點變成多重觀點；從單一學習者變成一個或多個彼此合作的團體。當學習情境變得更複雜，且較不易掌控時，教學設計者往往很難在有目的但非絕對必要性的學習以及有明確的原則學習之間取得平衡。這種複雜的學習情況成爲教學設計者及研究者在發展何種教學配合何種科技才是最佳學習型態時的一大挑戰。在衆多解決之道中，有一種是確認利用資訊科技的過程，並將設計及管理目標結合(Wilson, et al, 1995)。

高登(1983)在他的多重智力研究中批評智商的觀念及智力的單一觀點。根據他對腦部受損病人及具不同能力的學習者身上所做的研究結果，他將智力分成七大類：語文、邏輯、數學、視覺／空間、音樂/韻律、身體／運動及人際關係等。高登的理論暗示老師、課程設計者、媒體或電腦專家以及評量專家應該共同設計課程，如此才能使學生有機會發展出不同類的智力，而他們的學習成果也才能被適當的評量。雖然大家很清楚高登的理論，但是卻很少人實際將他的理論運用在正式的教育制度中。我們應該很清楚，目前在大多數國家中，考試仍多偏重於學業成就，尤其強調語文、數字方面的競爭。然而有愈來愈多的人試圖打破這種傳統的評量方式。新加坡在教學科技二千年的計畫下，學習評量可能會在不久的將來會有所改變。

上述認知一建構理論以及多重智力理論確實提供教學設計者在設計教學時一些很好的原則及指引。但是如何適當的使用及應用教學科技的問題卻尚未解決。

譬如，老師必須學會在使用媒體前如何去評估市面上成千的軟體？再者，老師是否可以在學校獲得好的軟體？而他們又如何將這些好的軟體與課程結合？另外，如果老師已受過訓練，他們的學生是否可以在適當的時間和地點使用電腦及軟體？

目前而言，新加坡很多學校都受到時間和空間的限制，尤其是當大班級及學生人數衆多，而又希望使用媒體及電腦教室的時候。平均來說，每1200位學生只分配到一間媒體教室及兩間電腦教室，另外，即使我們有訓練有素的媒體及電腦專家，一些學校技士出缺，也使得我們的老師苦無適

當的技術支援。

適當的使用教學科技因此與教學傳遞及學習架構產生關連。究竟我們提供給新加坡學生一些什麼？在十五億元的教學科技二千年計畫下，新加坡教育部成立一個教育科技部門，專門負責計畫、設計、應用及管理在職老師訓練及教學科技的課程及系統發展。在此計畫下，新加坡的學生與電腦的比例在小學是20:1，在中學則是15:1。國立教育學院負責訓練所有3500位未來將是老師及教育行政人員的學生，並且提供在職老師訓練的諮詢。另外，一個爲學校訓練資深教學科技者的計畫也已展開，共有四名來自教學科學部門及國立教育學院的老師參與這項計畫。除此之外，一些研究計畫也正研究如何適當的將教學科技與學校課程結合、如何運用教學科技來提高學生的學業成就，以及如何幫助學生在工作前做好準備。

以下我想和各位分享其中一項研究。

新加坡利用教學科技的例子 — "SUCCESS" 計畫

"SUCCESS" 是一個策略性應用電腦以改進新加坡中學修讀工藝組課程(3)學生學習成效爲目的的計畫。一般來說，工藝組學生是最不重視學業成績的，在該研究中，是以電腦應用這個主題來進行。爲了計算學生利用電腦的成本，特別在四所參與研究計畫的鄰居學校(4)中先做評估，以發展出在英文、數學、科學、電腦應用等課程之教學策略(Chen & Oei, 1996)及可用的工具(Looi, et al, 1996)，以便得到更好的學習效果與更高的學業成就。

這項計畫是以建構主義、社會認知論，以及合作學習的學習理論及原則爲架構(Brown, et al, 1991; Chaiklin & Lave, 1993; McCarthey & McMahon; Bershon; Nelson-Le Gall, 1992; Johnson & Johnson, 1989; Vygotsky, 1978)。"SUCCESS" 提出利用電腦做爲一種工具及系統，以一種整合性、主動性及深入學習的方式來整合課程的學習。這個計畫不僅著重於特定主題，更將課程與現實生活結合。因爲眞實的生活經驗、學習及練習三者是被視爲相連的活動，它們彼此間是互補的，而非相互排斥。

一項先導計畫先在一所學校執行，此先導計畫要學生做些與購物及消費選擇有關的調查，然後再利用電腦分析及呈現他們的發現。共有21位學生參與這項爲期二週的計畫，他們共分成四組，分別各有6,7,5,3位學生。有一位老師先與學生討論購物的主題，然後她再與每組學生商討所要研究的問題。學生必須設計自己的研究，製作調查表，進行調查，然後分析結果。此計畫同時要求學生要利用MS Word電腦軟體去做他們的計畫、分析及報告。研究者與師生彼此間也利用MS Word的大綱功能去設計研究，並利用圖畫功能來呈現資料。另外，這個計畫也教學生利用EpiGame軟體來組織及轉換資料。

拉飛與吉尼(Laffey & Gibney，1996)提出一個以學生爲中心的評量模式，是以五項後設功能做爲評量的依據，這項先導計畫正可用這些後設功能來評量學生：

*1.*機智性：當學生在準備他們的調查表；出去超市、購物中心購物時，表現出他們的機智性。他們執行他們的調查，利用MS Word及Power Point的繪圖功能來描述他們的結果。雖然他們事前曾與老師或研究者討論，但他們所表現出的結果全是他們的原始構想。

*2.*實際性：學生選擇他們個人認爲有意義的問題，且能對受訪者提出相關問題。

*3.*省思性：自我省思及自我評估在這些學生身上並不明顯，但是在其中兩份報告中，仍可看出學生有做自我反省。後續的"SUCCESS"計畫會強調這部份，因爲我們認爲自我檢視及自我評估技巧會讓學生的學習有不同的結果。

*4.*延伸性：學生並不會去思考他們的作業會如何繼續及延續，這個計畫後來才告知學生在現今社會中，意見調查是很重要的。

*5.*連結性：學生不會把他們做的作業與現實生活連結在一起，但這次的計畫提供了一個開始。

基於以上的發現，我們獲知，以計畫的方式，跨領域且有特殊學習目標的學習對學生是有益的。這項研究再次確定學生是將知識建構起來來做作業。拉飛與吉尼(Laffey & Gibney, 1996)指出：

〝當學生把自己的研究計畫當一回事，而別人也把學生的研究計畫當一回事的時候，學生會學習到有價值的能力，並且建立出一個心智模式。〞

"SUCCESS" 計畫是一個如何利用電腦結合英文課程的例子。電腦軟體，如MS Word及Power Point被用來做爲結合及呈現學習成果的工具，不論軟體或硬體，如果有計畫，且在控制的情況下運用，能獲得超越老師及研究者期望的顯著成果。除了學習一些語言及電腦技巧，學生還需要一些合作學習及社會技巧，以顯現他們在機智及深思方面的能力。這個經驗似乎提升他們的自信及自我評價，如果指引得當，學生能發展出一些原先他們未預期的自信與自我評價。他們不但被引發動機去學習，而且那些原先被視爲低成就學生也表現良好，當他們呈現他們的結果時，整個學校的老師對他們的表現大感意外。

未來教學科技及學習的遠景

從新加坡〝怕輸〞經驗，以及我們近日對於有策略地應用電腦來建構有效學習的研究，我們學到一些經驗，這些經驗可以用來計畫二十一世紀教學科技的應用。爲防止資訊科技在學校及訓練機構誤用及不被採用的情形發生，所有教育者、老師、訓練者及研究者在設計學習系統、活動及內容時應遵循以下標準：

－實際的學習目標及範疇

－與各學習社區合作

－以學習者爲中心，並提供問題解決的機會

－在有目的及可控制的情況下，適當的將科技當做一種學習過程及工具來運用之

提倡及教育如何適當的運用標學科技不僅在中國大陸、新加坡、美國，甚至世界各地都是一個長期且艱辛的過程。我們聚在一起，可以讓我們的學習社會有所改變。誠如所羅亞(William Soroyan)所言：

〝好人是好的因爲他們從失敗中獲得智慧。

我們很少從成功中獲得智慧。〞

從新加坡〝怕輸〞及〝怕失敗〞經驗，我們希望學到一些經驗，那就是在未來的世紀來臨前先把自己準備好。身爲教育學者及教學科技者的一員，我想勸告所有參與者共同爲適當的採用科技而努力。我們必須從這次莊嚴的場合踏出第一步，而透過網際網路進行密切的合作，或是教換經驗及成果，還有透過類似這樣好的研討會彼此交談等方式，我們應該可以做得更多。

註　解

1. 〝怕輸〞(Kiasu)是源於福建方言的新加坡用語，形容害怕失敗，通長是用在做太多事後的結果。〝怕失敗〞(Takut)則是馬來文用語，與〝怕輸〞同義。
2. 皮爾門是哈得遜研究院(Hudson Institute)〝2001年學習方案〞的主持人，在他1992年出版的書〝學校出局〞(School's Out)中提出：
   —廢除學位制度
   —公立教育制度受商業剝削所困
   —讓學習運用到每一個年齡層，這種作法在軍事及商業界早已如此進行
   —建立資訊高速網路以提供超學習給大家
3. 工藝組學生是一些在小學成績最差的學生，他們在新加坡的中學中也常被視爲學業導向最低的學生。
4. 〝鄰居學校〞(Neighbourhood School)在新加坡是接受住在學校附近的小孩，他們沒有任何特別的學科入學標準。

Mr Kiasu and IT: Sharpening our focus on technology - enhanced learning

Abstract

The ability of the Singapore workforce to continually upgrade its skill levels in order to keep pace with the rapidly changing developments in the world, particularly in science and technology, is of vital importance to Singapore's economic survival and success. Each worker has to be equipped with the necessary knowledge, skills, and values to learn independently and to solve problems at a pace demanded by the nature and contingencies of the work. Technology, in particular audio visual media and materials, have been powerful in facilitating information retrieval and acquisition. It has open up new avenues and challenges for enhancing the process of knowing and learning. The emphasis of teacher education has always been on the *appropriate* use of *appropriate* technology for *noly* those aspects of learning that will *truly* be enbanced. But evidences of misuse and under-use of technology in the schools and in other training institutions abound. Two major reasons can be traced: first the *kiasu* syndrome among the progressive teachers, and second, the *takut (insecure or fear)* syndrome among the conservative teachers.

This paper addresses the above prevalent phenomena in the Singapore education system. It emphasizes the urgent need for teachers and teacher educators to refocus our attention on IT as instructional technology and IT as information technology in the midst of rapid changes in the world of work, and in education. To sharpen our use of appropriate technology, it is necessary for us to reexamine the acts of knowing, learning, and teaching in the light of recent educational research findings. It is also necessary for us to review our understanding of the process of knowledge and skill construction, application, and collaborative efforts to train high performance learners and learning communities in workplaces.

Some current research efforts to integrate IT within the school and teacher training curricula will be examined and discussed. Among them is *Project SUCCESS* - the Strategic Use of Computers for Constructing Effective StudieS -a research project that inquires into the use of the Constructivist approach and the computer as a tool across curriculum to bring about more effective learning and higher academic achievement among Singa-

pore's Normal Technical secondary students in two schools. The pilot project involves students in one school doing a survey-based project on some aspects of consumers' choice when shopping, and analysing and presenting their findings using the computer.

Lessons from the above experiment project and the *kiasu* or the *takut* syndromes of the past could shade light on future IT in education developments and appropriate use of instructional technologies in the preparation of high-performance learners and learning communities. The future involves the formulation of more realistic goals and contexts, more focussed planning and design, with the implementation of more learner-centred learning, more authentic and appropriate learning tasks, and more appropriate use of technology as process.

Mr Kiasu and IT Sharpening our focus on technology — enhanced learning

A Personal Note

I would like to share with you my personal experience with IT as a student and a teacher, first in Hong Kong, then Mainland China, and later in Singapore and the United States.

When I was a student in the 50's and early 60's, it was mainly chalk and talk in the classrooms. The good teachers were excellent oral presenters, witty and facile with language, both verbal and non verbal. We, the students, were good listeners and copiers. When I was trained to be a teacher in the 60's, I was taught to use pictures, maps, models, records, tapes, slides and films. Some *kiasu* (1) teachers were so excited with the availability of the variety of media that they misused them. The majority carried on teaching unchanged in methodology. The late 60's and 70's was the era of television, *Mr Kiasu* in Singapore would probably feel something missing if television lessons and video tapes were not added to the piles of media materials and equipment in his class. The 80's marked the advent of the computer. Its name, and profile for improved learning through drill and practice and tutorial programmes was so tantalising that some *kiasu* teachers overused computer language and maths programmes while most of the teachers felt rejected and outcast.

By the 1990's the promises of the personal computers for information retrieval, extension and transformation were so great that American scientists such as Lewis Perelman and the like pronouonced the death of schools and the formal education system. The new technology and so-called 'hyperlearning' system which could enable anyone to learn anything, anywhere, anytime, with grade 'A' results were to revolutionise learning. In Singapore, the Minstry of Education looked to the National Computer Board to take the lead in the design and development of educational software such as the Student -Teacher Workbench (STW), and we soon heard not only of 'demo schools' but every 'enlightened' teachers and principals trying to jump on the IT bandwagon. Instructional technology- IT- became synonymous with information technology and progress. *Mr Kiasu* would certainly not wish to be left out of the technological race.

In 1995, with the announcement of National IT2000 Plan, every education institution in Singapore including the National Institute of Education not only makes plans but is in the process of implementing ambitious programmes. Such is the plight of the teach-

ers and teacher educators of the 1990's in a rapidly changing world. The slogan is "Use IT or become *it- the obsolete one*"!

Many teachers soon asked: "Is IT the answer to Singapore's economic survival and success ?" " Will the computer alone enable the workers to keep pace with the rapid changes in the workplace?" "Does knowing about IT automatically lead to learning about other subjects ?" " Will IT really facilitate the building of high-performance learning communities?"

A Shared Experience

With all the hype of IT in our society, I would like to put in perspective the role of media and information technology in our psychology of knowing and learning.

We know about something by seeing, hearing, tasting, smelling and touching. Each of these direct experiences enables us to know a bit more about human nature and the environment through sensory means. We also learn via diverse media and acts of doing. Truly, we learn to do something by doing it. The action enables us to acquire new meaning, new understanding and new or improved skills. Knowing may involve mainly sensory means but learning involves more complex mental processes such as remembering, thinking, and problem-solving.

We teach someone when we understand and listen to his/her questions, his/her stories and his/her woes, not necessarily by giving instructions, imparting or producing knowledge. We teach something when someone understands our explanations and shares with us his/her understanding and interpretation. Our mutual understanding is the beginning of a series of interaction in the process of learning and teaching. Our mutual exchange generates more knowing, more learning and understanding.

Knowing, learning and teaching are closely related forms of human activity that should be considered holistically rather than as discrete independent acts. From our professional experience, we know that technology, both as process and product, can enhance our knowing, learning and teaching. The problem is the phenonmenal growth in technological products, terms and languages without a parallel development in the process of learning with technology. This phenonmenon has created anxiety, confusion, misconceptions, and misuse of technologies among the teachers, alas, even among the teacher educators.

We do not learn or teach everything with the computer to achieve *Hyperlearning* ,the *New Technology and the End of Education* (2) as proposed by Perelman of Project Learning 2001 of the Hudson Institute. Every kind of technology should be used appropriately and wisely. 'How to use technology' or the process of bringing about learning and teaching with the computers should be our major concern and focus. More computers and

computer software and courseware do not really facilitate the learning of necessary knowledge and skills. More hours of training also do not automatically translate into direct applications in the workplace.

Teachers in general know how to acquire new tools and skills to use such tools. The problem is not acquisition. The crux of the problem is utilisation, appropriate use of technology. We, teachers, get attached to our tools. We get used to ways of using some tools. We are not willing to discard familiar tools or methods of learning, teaching and assessment. The time has come for some rethinking about all the technologies that claim to enhance learning. There is a time to collect and a time to discard, a time to build and a time to destroy, a time to reconstruct, to transform and to create.

I would like to suggest some ways to refocus our vision for IT in the light of new developments in the psychology of knowing, learning and teaching, as well as that of the developments in technologies. Let's first take a close look at IT as a field of study and practice.

A Close Look At IT

Conceptions, Misconceptions and Creations

IT as instructional technology

Since 1977, the American Association for Educational Communication and Technology, has defined instructional technology as "a complex, integrated process involving people, procedures, ideas, devices and organization, for analysing problems and devising, implementing, evaluating and managing solutions to those problems, in situations in which learning is purposive and controlled".

The focus of instructional technology based on the above definition is still relevant today as the emphasis is on *process* and not on *products* or *devices*. IT is not whether we use chalk and talk, or television, or computers. It is about the appropraite and effective use of technology both as process and as product for 'purposive and controlled' learning. To ensure that technologies are used appropriately and effectively, our focus should be on the principles of design, development, implementation, evaluation and management of open systems of learning and not on a specific tool or machine, or on a specific set of procedures.

Closed learning systems that rigidly follow a set of procedures will not be flexible enough to adapt to rapid changes. The preference is, therefore, for the design, development and utilisation of open systems, not tidy, neat, linear instructional design models and systems that are firmly rooted in Behaviouristic theories, and stimulus-response and

reinforcement principles. The recent emphasis on Cognitive-Constructivist perspective of learning is an attempt to bringing about more meaningful and active learning, as well as problem-solving by the learner. The focus is on the learner and his/her process of learning, *purposeful* and *controlled* by herself/himself as far as it is possible, as well as the resources that will enhance his/her learning, not only in school, but for life, now, and in the future.

IT as information technology

Information technology, according to 1987 Edition of Longman Dictionary of Contemporary English, is "the science or practice of collecting, storing, using and sending out information by means of computer systems and telecommunications". IT in the context of today focuses on the computer systems and telecommunications as well as the study and the practice of collecting, storing, using and sending information. The field of IT in this instance is broad. It may, or in most cases, may not concern itself with the deliberate act of instruction.

Teachers should, therefore, use the term IT to mean the collection, storage, use and transmission of information via computer systems and telecommunication networks. The appropriate use of IT as information technology should, therefore, include the design, development, implementation, evaluation and management of computer systems for learning and teaching purposes. It should not just concentrate on the transmision process. IT should heighten the purposes and avenues of knowing, and facilitate the process of learning and teaching using as many of the capacities of computer and telecommunication systems. Among the capacities to be exploited are those connected with networking, and multimedia capture, storage and distribution of text, images, graphs, and videos.

To illustrate, let me show you some examples of good computer programmes that play the role of an active agent in sharpening knowing, and facilitating learning and teaching. (Examples from *Classroom Management* by Instructional Science Division, NIE to develop understanding of real classroom situations and problem-solving skills; and *Thinking Things* by Edmark to develop a variety of thinking skills: memory, critical thinking, problem solving, and creativity in art, language, maths, music, science)

These programmes have been created based on sound cognitive and pedagogical principles for learning and teaching, as well as sound design principles briefly described in the following section.

Overview of Constructivist Approach to Technology-Enhanced Learning

Principles, guidelines and constraints

From an analysis of the good computer-based programmes, it is quite apparent that the instructional designers have followed some key principles of knowing and learning based on two major schools of thought on human development and intelligence.

The first cluster of principles about readiness, about matching instruction with the child's stages of intellectual development, and about the influence of culture and the society on the learners are derived from theories such as those of the Cognitive-Constructivist perspective, e.g. Piaget's theory of *cognitive development and development of thought* (Piaget,1926, 1977),Vygotsky's theory of *zone of proximal development and historical sociocultural theory of higher mental processes* (Vygotsky, 1924, 1978), and the more recent Lavian and Chaiklin theories on situated practical activities (Lave and Chaiklin, 1993). The second cluster of principles are related to Howard Gardner's theory of *multiple intelligences* (1983).

For Piaget, a child's intellectual and moral development are related to their physical and emotional development in terms of age and stages. A learner learns best if there is a close match between his cognitive and physical developments, Therefore it is difficult for a child to learn about abstract ideas and concepts if s/he is still functioning at the concrete operational stage. Audio visuals assist the child to concretise her/his experience, hence they should be used to enhance learning particularly abstract concepts and distant or indirect experiences. Bruner (1966) and Dale (1969) have translated Piaget's thinking into more practical terms in spellig out the intermediate state as 'iconic experience' which bridges direct enactive experience with abstract symbolic experience and development. While Bruner and Dale would recommend the use of audio visuals to provide the desirable 'iconic experience', teachers have to use their discretion to decide *when* and *how* to use them in the classroom or outside the formal schooling system. They could only do so if they know not only the principles of media selection but also the availability of supporting facilities and manpower for implementing appropriate IT use.

For Vygotsky, the mechanism of individual developmental changes is rooted in society and culture. Hence his theory of Zone of Proximal Learning in particular in the development of language and thought, the understanding of cultural artifacts and symbols are the foundation of socio-constructivism. The work of his followers who expounded cognitive apprenticeship, situated learning, anchored instruction, authentic learning tasks and groups interacting with technology (Brown & Duguid, 1991; Chaiklin & Lave, 1993; McCarthey & McMahon; Bershon; Nelson-Le Gall, 1992; McGrath & Hollingshead,

1994; Johnson & Johnson, 1989; Vygotsky, 1924, 1978) all have implications and can provide valuable guidelines for the design, development and implementaiton of learning systems and activities interacting with technology.The systematic and systemic nature of technology as a process can provide useful frameworks for the design of meaningful learning and teaching that relates to confronting and solving real life problems.

Constructivist and socio-constructivist type of learning shifts the learners from a passive learning mode to a more active problem-solving mode, from a singular perspective to multiple perspectives, and from an individual learner to a group or multiple groups cooperating and collaborating with each other. As the learning situation becomes more complex and less controllable, instructional designers often have difficulty in balancing between purposeful yet not necessarily with explicitly defined principles and rules types of learning. The complexities of the learning situation thus pose a big challenge for the instructional designers and researchers in their attempts to develop models of learning and models of inquiry into what kind of pedagogy with technology really works. Some proposed solutions include a balanced integration of design and management goals that include the definition of monitoring routines and procedures using information technology (Wilson, et al, 1995).

Howard Gardner (1983), in his seminal work on Multiple Intelligences, critiques the concept of IQ and its unitary view of intelligence. Based on his research on brain-damaged patients and learners with different abilities, he identified seven aspects of intelligence : verbal/linguistic, logical.mathematica, visual/spatial, musical/rhythmic, bodlly/kinesthetic, interpersonal and intrapersonal abilities.

Gardner's theory implies that teachers, curriculum planners, media or computer specialists and evaluation specialists should come together to design a curriculum in which students have a chance to develop these different aspects of intelligences and be appropriately assessed for their learning outcomes. His theory, though well-received, has yet to be realised in practical terms in the formal education system. We are familiar with the current examination practice in most countries that are still weighted on the assessment of academic achievements focussing on verbal and numerical competencies. However, an increasing number of attempts to break through the traditional mode of assessment have emerged. In Singapore, under the IT 2000 for Education, we may witness the beginning of changes in the assessment of learning outcomes in the near future.

The above Cognitive-Constructivist and Multiple Intelligences theories do provide the instructional designers with sound principles and general guidelines for designing and planning instruction. And some good computer-based programmes are now available for use. But the problem of implementation and of appropriate use of IT have not been solved.

In the first instance, teachers have to learn how to evaluate the thousands of programmes that are available in the market before they can decide on their appropriate use. Second, do teachers have access to the good programmes in schools and how can they integrate the good programmes into the curriculum? Third, if the teachers have been trained, would their students have access to the computers and the programmes at the right time and in the right place?

The current situation in Singapore shows that many schools suffer from the constraints of timetabling and space as there are a large number of classes and students desiring to use the available media and computer laboratory facilities. The average is one media lab and two computer labs to one school with an average of 1,200 pupils. Our teachers are also constrained by inadequate technical support even though there are trained media and computer coordinators as well as unfilled positions for technicians in schools.

The appropriate use of IT is therefore also linked to the instructional delivery or learning infrastructure. So, what is in store for the Singapore learners? Under the 1.5 billion dollar IT 2000 Plan (education), a new Division for Educational Technology has been set up by the Ministry of Education to plan, design, implement and manage both in-service teacher training as well as IT curricular and systems developments. Under the Plan, every primary school in Singapore will have a pupil-computer ratio of 20:1 and 15:1 for secondary schools.

The National Institute of Education takes charge of the Initial Training of all of the 3,500 student teachers and educational administrators, and consults in the in-service training of teachers. A programme to train senior IT trainers for schools has already started and four members of the Instructional Science Division, National Institute of Education are involved in the training. In addition, research projects have been initiated to inquire into the proper integration of IT into the existing school curriculum and the potential of IT raising the academic achievement of students and in preparing them for the workplace.

I would like to share with you one of these research projects.

An Example of Appropriate Use of IT in Singapore - Project SUCCESS

SUCCESS is a project that proposes an approach to improving the academic learning of secondary Normal Technical (3) students in Singapore through the strategic use of computers in the school curriculum. The Normal Technical (NT) students are least academically-oriented students of any cohort. They have been given a special subject to study- Computer Applications and have done well in this subject in the past three years. Capitalising on the NT students'interest in using the computer, an inquiry is being carried out in four participating *neighbourhood* schools (4) to develop instructional strate-

gies (Chen & Oei, 1996) enabling tools (Looi, et al, 1996) in English, Maths, Science and Computer Applications to bring about more effective learning and higher academic achievement.

The proposed learning approach is undergirded by constructivist, social cognition, and cooperative learning principles and theories (Brown, et al, 1991; Chaiklin & Lave, 1993; McCarthey & McMahon; Bershon; Nelson-Le Gall, 1992; Johnson & Johnson, 1989; Vygotsky, 1978). SUCCESS proposes the use of computers as a tool and a system for integrating curricular studies through an integrative, active and deep approach to learning. Its focus is not just on specific subject area but linking curricular subjects and concerns with the real world of work. Real life experiences, learning and work practices are viewed as interlocking human activities that complement each other rather than in conflict with each other.

A pilot project has been conducted in a school which involves students doing a survey-based project on some aspects of shopping and consumers' choice, and analysing and presenting their findings using the computer. For two weeks, 21 students participated in the study and were grouped into 4 groups of 6,7,5 and 3 students each. The English cum Computer Application teacher had an initial session with them to discuss the topic of shopping. She then worked with each group of students to negotiate and agree on a research question. The students are required to plan for their research, produce a survey form, conduct the survey, and analyse the results. They are expected to use MS Word to support them in their planning, analysis and writing. The researchers worked with the teacher and the students in using the Outline feature of MS Word to plan the research and the graph feature to present the survey data. A prototype software - the EpiGame with features for categorising information and transforming them into coherent knowledge was also introduced to the students.

A new assessment model proposed by Laffey & Gibney (1996) with five metafunctions as a potential beginning point for examining student-centered projects was used. The students' performance in this pilot study could be assessed in terms of these metafunctions:

1. Resourcefulness: The students demonstrated this in preparing their survey forms, going out to places like the supermarkets, shopping centres, and wet markets. They conducted their survey, and used the graphing functions of MS Word and Power Point to depict their results - all on their own initiatives, even though they did consult their teacher and the researchers.
2. Authenticity: The students chose problems which they perceived as personally meaningful and were able to ask relevant questions of the interviewees.
3. Reflection: Self-reflection and self-assessment were not so apparent among the students. Two of the four reports, however, showed that the students depicted

evidences of reflective thinking in their journals. Subsequent studies in the SUCCESS project will have to highlight this aspect as we believe that self-monitoring and self-assessment skills can make a difference in the students' learning.

4. Extension: The students did not think about how their work can be continued and extended until it was pointed out to them the importance of Opinion Survey in real life nowadays.
5. Connectedness: The students were not yet able to make connections between the project experience and other significant parts of their life in the community. But a beginning has been made.

Based on the findings, we have a better idea that a project-based cross-subject approach with specific learning objectives is beneficial to the students. This study reaffirms the value of students doing projects by constructing information together. Laffey & Gibney (1996) noted that:

> "Students learn valuable competencies and begin to build a mental model of what it means to do research projects when you are serious about your project and *when people take your project seriously*." (italics are the researchers' understanding).

Project Success is an example of how Computer Applications can be integrated into the English language curriculum. Computer software, in this instance, MS Word and Power Point, were used as tools for integration and presentation of ideas and academic learning. Both the hardware and the software, if used purposefully and in a controlled fashion, could achieve significant results that exceeded the expectations of the teacher and the researchers. Besides learning a great deal about language and computer skills, the students have acquired some cooperative learning and social skills and shown qualities of resourcefulness, and some reflection. The experience seemed to have raised their confidence and self esteem. If guided properly, the students may develop in areas that are totally unexpected. They have not only been motivated to learn but the so-called lower ability students presented themselves so well that the entire school staff who were present at ther presentation were really surprised by the academic outcome.

A Longshot of the Future of Instructional Technology and Learning

From Singapore's *kiasu* experience and our more recent inquiry into the strategic use of computers in constructing effective studies, a number of lessons have been learned. These lessons have serious implications for the planning of IT use in the 21st Century workplace. To preempt misuse and underuse of information technology in schools and training institutions, it is important for all educators, teachers, trainers and teacher educators, and researchers, to design learning systems, activities and tasks that meet the

following criteria:

- Realistic learning goals and learning contexts
- Collaboration among members of a learning community
- Learner- centred types of learning with opportunities for active problem-solving
- Authentic and appropriate tasks that are embedded in real life situations
- Appropriate use of technology as process and tools in *purposeful* and *controllable* situations.

The promotion and education of appropriate use of instructional technology is a long and arduous process throughout the whole world, not only in China, Singapore and the United States. We in this gathering can make a difference to our associated learning communities. To quote William Soroyan,

" Good people are good because they've come to wisdom through failure.
We get very little wisdom from success".

From Singapore's *kiasu* and *takut* - fear of failure - experience, we hope to have learned a few lessons that can better prepare us for the coming Millenium. As members of the larger learning community of educators and educational technologists, I would like to exhort all present to make the effort and to take the lead in the appropriate use of technology. We have taken the first step on this august occasion. We can do more by having closer collaboration on the Internet, by exchanges of experience and products, and in similar conversations in a wonderful conference such as this one.

Notes

(1) 'Kiasu' is a Singapore term based on the Fukien dialet. It describes a syndrome of fear of failture, usually resulting in overdoing things. 'Takut' is a Malay term which has the same meaning.

(2) Lewis J. Perelman is the Director of *Project Learning 2001* at the Hudson Institute, a prestigious American Think Tank. In his book, **School's Out**, published in 1992, he proposes among others:

- Abolish the credential system
- Push for the complete commercial privatization of the public education system
- Implement for learning at all ages the hugh breakthroughs that have already been developed in the military and commercial sectors
- Build the information superhighway network that can deliver hyperlearning to everyone.

(3) Normal Technical (NT) students are those with the lowest scores in the Primary School Leaving Examinations and are often perceived to be the least academically-oriented students in Singapore's secondary schools.

(4) "Neighbourhood schools" in Singapore receive children of residents who live in the vicinity of the school in a neighbourhood without any special academic admission criteria.

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