CANADIAN JOURNAL OF EDUCATIONAL COMMUNICATION

Volume 17, Number 3, Fall 1988
ISSN 0710-4340

An AMTEC Publication

Canadian Journal of Educational Communication

Volume 17, Numbers
Fall 1988

ISSN 0710-4340

The *Canadian Journal of Educational Communication* is published quarterly by the Association for Media and Technology In Education in Canada; 500 Victoria Road North; Guelph, Ontario N1E 6K2; Canada; Attention: Mr. Ron Eyre, Secretary/Treasurer. Notification of address change should be sent to the above. Back issues of CJFCareS 10 Canadian and may be obtained by contacting the Editor. CJFC is indexed in the *Canadian Education Index* and ERIC.

Second Class Mail Registration No. 6956

All correspondence should be addressed to:

Dr. Robert M. Bernard, Editor
Education Department
Concordia University
1455 de Maisonneuve Blvd. W.
Montreal, PQ, Canada H3G 1M8

CJEC Is typeset on an Apple Macintosh Plus™ In PageMaker 2.0™. Galley proofs to authors and final camera-ready Impressions are output on an Apple LaserWriter™.

Printing: Concordla University
Printing Services

CJEC ORDER FORM

CJEC is free to members of AMTEC. However, many prefer to order the journal separately, and may do so by completing the form below:

(Name)

(Address)

- [ ] $ 40.00 (Cdn.) annual subscription
- [ ] New Subscriber
- [ ] Renewal
- [ ] Please send me information about AMTEC and a membership form.

CHANGE OF ADDRESS

Send this form to:

Mr. Ron Eyre
AMTEC
500 Victoria Road North
Guelph, Ontario N1E 6K2
Canada

Commentary

Tendances et Prospective en Applications Pédagogiques de L'Ordinateur

Philippe Duchastel
Pierre Pelletier

Résumé: Les applications pédagogiques de l'ordinateur sont appelées à évoluer vers des formes d'interaction beaucoup plus flexibles et motivantes pour l'étudiant. Nous considérons ici les différentes formes d'APO qui prennent actuellement de plus en plus d'Importance en recherche et en développement dans ce domaine, en particulier les Jeux éducatifs, les environnements exploratoires, le vidéodisque Interactif, et les systèmes tutoriels intelligents. Notre analyse insiste sur les avantages particuliers de l'ordinateur et sur les modèles d'apprentissage en APO. Les tendances actuelles décelées mènent à des considérations de prospective pour les APO.

Abstract: Computer applications in éducation will Inevitably evolve we feel, towards Systems which are more flexible than present-day Systems, and which also capture student motivation to a greater extent. We consider hère différents forms of computer applications in éducation which seem particularly promising in thèse respects. Thèse include computer games, exploratory learning environments, interactive videodisks, and intelligent tutoring Systems. We believe that artificiel intelligence will hâve a strong impact in thé area of computer applications in éducation.

INTRODUCTION

L'éducation contemporaine a pour tâche d'intégrer les nouvelles technologies à l'enseignement de sorte à profiter pleinement de ce qui fut appelé le virage technologique. L'élément central de ces nouvelles technologies est l'ordinateur, et déjà des applications fort diversifiées ont été réalisées dans tous les secteurs éducatifs. Les technologies informatiques sont cependant loin d'être stables: de nouvelles possibilités matérielles et des applications nouvelles qui en découlent font leur apparition de façon continue. Ces technologies constituent en effet un domaine en évolution créative constante, et il est important que les chercheurs et les décideurs publics suivent cette évolution de près et la guident de façon appropriée dans ses applications locales.

Cependant cette intégration de l'ordinateur en éducation ne se fait pas sans problème. Kurland (1983) indiquait:

> If one takes a look at any of thé educational computing magazines or talks to teachers struggling with their first computer, a général impression émerges that educational software is often poorly conceived, "buggy", difficult to use, difficult to integrate with thé rest of thé curriculum, and designed without regard for thé range of needs and abilities of students. (p.4)

Cet article porte sur les capacités actuelles et potentielles de l'ordinateur en éducation, tout en faisant une place spéciale aux apports de l'intelligence artificielle (IA) dans ce domaine. Même si la géographie des APO de demain demeure très difficile à bien définir, il apparaît déjà de façon générale que l'IA soit appelée à y jouer un rôle majeur. En effet, tout l'intérêt suscité depuis quelques années pour l'IA n'est pas un phénomène artificiel, mais bien le reflet d'une révolution mineure en informatique même. Il s'agit essentiellement d'une extension importante de l'informatique vers des applications à caractère réellement symbolique et heuristique. Nous nous permettons de croire que d'ici 10 ans, tout logiciel pédagogique comportera des éléments d'IA dans son fonctionnement.

Dans un premier temps, nous situons notre analyse par rapport aux modalités d'applications de l'ordinateur que sont l'enseignement directif, l'apprentissage de la programmation et l'ordinateur comme outil pédagogique. C'est surtout cette première modalité qui nous intéressera par la suite, et nous en examinons le potentiel par l'intermédiaire de trois avantages que procure l'ordinateur en enseignement: le diagnostic rapide, l'intérêt soutenu de l'élève et la simulation symbolique. Ce sont là des capacités qui sont aisément exploitables dans des applications faisant intervenir l'intelligence artificielle, comme nous le soulignerons plus loin, surtout parce que ces types d'applications sont davantage basées sur des modèles d'apprentissage cognitifs que le sont les applications traditionnelles.

Cependant, les tendances actuelles en APO font ressortir surtout des types d'applications qui s'éloignent des applications traditionnelles sans pour autant être révolutionnaires. Ce sont les jeux éducatifs, les environnements exploratoires, le vidéodisque interactif et les sytèmes tutoriels intelligents. Ce sont là les types d'applications qui, se basant de plus en plus sur l'intelligence artificielle (c'est évident dans le dernier cas), feront surtout progresser les APO au cours des prochaines années. La prospective que nous entrevoyons est centrée sur une certaine maturité d'exploitation des APO, sur des équipements informatiques sophistiqués et, bien sûr, sur une informatique intelligente.

Les modalités d'application de l'ordinateur en éducation

La litérature identifie de plusieurs façons les modalités d'application de l'informatique dépendamment des usages qu'on en fait et des objectifs que l'on vise. De façon générale, l'on peut considérer, à la suite de Kurland (1983) et de Sheingold (1984), une catégorisation des applications de l'ordinateur en éducation selon trois modalités principales: dans le cadre d'un enseignement directif, comme instrument d'apprentissage de la programmation et comme outil pédagogique.

Enseignement directif. Selon cette modalité, l'ordinateur devient une machine à enseigner: un tuteur ou un répétiteur. Les objectifs dont l'atteinte est favorisée dans ce contexte sont surtout du type information verbale. C'est l'approche la plus ancienne et encore la plus répandue. Cette façon de faire a été promulguée avec force par les grandes maisons de publication qui conçoivent le logiciel pédagogique (souvent appelé didacticiel) au même titre que les volumes qu'ils produisent et qu'ils distribuent.

Apprentissage de la programmation. Dans ce cas, l'ordinateur est considéré comme objet d'apprentissage. On y vise l'atteinte d'objectifs relatifs à la connaissance de la structure et du fonctionnement de l'ordinateur et de ses périphériques, ainsi que la maîtrise de certains langages de programmation tels le BASIC, le LOGO ou le PROLOG.

Outil pédagogique. Cette approche exploite des logiciels utilisés principale ment pour traiter et gérer de l'information à des fins d'apprentissage, d'enseignement ou de gestion pédagogique. L'outil est ici considéré dans le sens de Bruner (1982), c'est-à-dire: "as an amplifier of human capacities and implementer of human activity" (p. 81). Ces logiciels comprennent des progiciels tels le traitement de texte et les systèmes de base de données.

Délaissons maintenant ces deux dernières modalités pour nous centrer sur le logiciel pédagogique en soi. Lesgold (1982) présente une analyse qui traite des avantages de l'ordinateur en éducation sous une rubrique révélatrice: "What cannot be done without a computer?" En effet, bon nombre d'applications courantes de l'ordinateur en éducation ne font que faire quelque peu autrement ce qu'il est possible de faire avec des moyens traditionnels. Ce qu'il convient plutôt de faire dans l'état actuel des APO, c'est de considérer le potentiel particulier de l'ordinateur (i.e., comment il peut vraiment enrichir la qualité de l'éducation au-delà des technologies traditionnelles).

Lesgold présente trois aspects particuliers de certaines applications de l'ordinateur en éducation, lesquels ne sont que très brièvement résumés ci-dessous.

Le diagnostic rapide. Une habilité majeure de certaines applications de l'ordinateur est de rapidement diagnostiquer chez l'étudiant des sources d'erreurs ou de fausses représentations cognitives. Les composantes du diagnostic, surtout lorsque les besoins sont complexes, dépassent souvent les ressources-mêmes des enseignants, de sorte qu'un système informatique sophistiqué, par exemle BUGGY (Burton, 1982), peut constituer un atout majeur dans ce domaine.

L'intérêt soutenu. L'habilité de l'ordinateur d'interagir rapidement avec l'étudiant a pour avantage de préserver l'attention de celui-ci lors de l'apprentissage. La composante ludique que l'on retrouve dans plusieurs des didacticiels actuels est reconnue comme un avantage additionnel dans cette même veine. Le pouvoir de l'ordinateur de capter l'attention dépend cependant de la justesse et de la cohérence de l'interaction, laquelle dépend elle-même de plusieurs facteurs, dont la sophistication de la représentation interne du contenu pédagogique dans le programme et de la situation d'apprentissage.

La simulation symbolique. L'ordinateur peut aisément étendre la gamme d'expériences pratiques dont peut profiter l'étudiant. La simulation informatique remplace en effet de nombreuses expériences de laboratoire qui sont soit difficiles soit dangereuses à réaliser en pratique. De plus, la simulation symbolique permet à l'étudiant de "jouer" avec les lois physiques et de s'apercevoir des représentations naives qu'il peut avoir à leur égard. Le système SOPHIE (Brown et al., 1982) est un exemple de ce type de laboratoire informatique; les logiciels en développement au Educational Technology Center de Harvard (Schwartz, 1984) en sont autant d'autres.

Ces trois aspects particuliers de l'ordinateur ont été exploités depuis l'avènement de l'enseignement assisté par ordinateur (EAO). Cela n'a pas toujours été fait cependant dans des conditions les plus propices à l'exploitation optimale des capacités offertes par la machine, cela en raison de diverses considérations techniques. Les progrès récents en informatique, et surtout en LA, laissent cependant entrevoir une possibilité de profiter pleinement de ces capacités.

L'enseignement intelligemment assisté par ordinateur (EIAO)

L'EIAO a été défini dès ses débuts (par le concepteur de SCHOLAR, le premier système EIAO — Carbonell, 1970) en termes de flexibilité d'apprentissage: le système, au moyen d'un dialogue à initiative partagée, permet à l'étudiant de contrôler la direction de l'interaction et en conséquence le cheminement de son propre apprentissage. C'est en général cette flexibilité offerte à l'étudiant qui caractérise, au niveau des processus cognitifs, l'avantage de l'EIAO sur l'EAO traditionnel (Duchastel, 1986a; voir également Duchastel, 1986b, pour une analyse détaillée du concept de contrôle par l'étudiant en EIAO).

Alors que l'EAO traditionnel vise un enseignement adaptif en réponse aux besoins inférés de l'étudiant, l'EIAO cherche davantage à stimuler un apprentissage adaptif à partir des intérêts de l'étudiant. L'adaptation en EAO traditionnel requiert essentiellement que tous les besoins potentiels de l'étudiant soient déterminés à l'avance par l'enseignant et inclus explicitement dans le système. Il s'agit là d'un processus largement algorithmique qui a pour conséquence de structurer souvent trop rigidement l'interaction éventuelle lors de l'apprentissage. A l'encontre de cette approche, la flexibilité d'interaction qu'offre l'EIAO donne à l'étudiant une plus grande initiative, lui permettant ainsi d'adapter lui-même l'enseignement à ses propres besoins cognitifs, tant au niveau de ses intérêts que de ses schèmes cognitifs. Il en résulte en principe une stimulation accrue, de même qu'un niveau d'adaptation plus raffiné.

Il faut cependant noter que cette caractérisation de l'EIAO demeure générale. En effet, les prototypes de systèmes existants sont très variés et abordent cette tâche centrale d'adaptation chacun selon leurs particularités propres (voir Sleeman et Brown, 1982, pour les systèmes particuliers, et O'Shea et Self, 1983, pour une analyse critique). Il faut aussi noter que la flexibilité en EIAO ne l'empêche pas d'être prescriptif lorsque l'exige la situation; c'est d'ailleurs là le rôle des modules tuteurs des systèmes EIAO. Une analyse des aspects proprement tutoriels des principaux systèmes EIAO est présentée par Duchastel et Imbeau (1986). C'est essentiellement cette dynamique psychologique qu'on retrouve dans le dialogue à initiative partagée qui est au coeur du problème de design pédagogique de systèmes EIAO.

La flexibilité d'interaction offerte par l'EIAO, et l'adaptabilité accrue qui en résulte, sont rendues possibles dans le design de tels systèmes par les techniques de l'IA. L'IA modularise finement les connaissances de telle sorte que le système puisse les recombiner de façon heuristique pour répondre de façon appropriée aux besoins courants de la situation lors d'une résolution de problème ou d'une interaction avec l'usager. La base de connaissances est établie en termes d'éléments sémantiques interreliés et non plus uniquement en termes d'éléments symboliques pré-formatés (Duchastel, 1986e).

L'IA cherche également (quoique non dans tous les cas) à faciliter l'interaction usager-machine au moyen de techniques de compréhension du language naturel dans des domaines limités. En effet, la flexibilité qu'offre l'IA suppose que le système puisse interpréter et réagir aux initiatives de l'usager, lesquelles sont difficilement formulables autrement qu'en langage naturel (dépendant de la sophistication informatique de l'usager, laquelle doit être rarement présupposée au départ). Les problèmes techniques à ce niveau sont complexes et il s'agit d'une thématique importante dans la recherche en IA. Un exemple sophistiqué en EIAO d'application du langage naturel (toujours dans un domaine restreint) est le système SOPHIE (Brown et al., 1982).

Cette section ne put qu'esquisser plutôt sommairement la nature de l'EIAO et ses principales problématiques. Des analyses beaucoup plus approfondies sont disponibles, de même que plusieurs exemples (voir à cet effet le volume de Wenger, 1987).

Modèles d'apprentissage en APO

Toute application pédagogique de l'ordinateur comporte implicitement une théorie didactique basée sur un modèle d'apprentissage particulier, même si celui-ci est diffus. Ce qu'est l'apprentissage et la variété de formes qu'il prend est un objet constant de recherches en psychologie scientifique, avec ce que cela implique de vues personnelles quant aux tendances théoriques adoptées. Toute attitude personnelle envers l'apprentissage influe donc sur le design de systèmes visant l'apprentissage, et il est par conséquent utile de considérer les grandes tendances dans ce domaine.

Brimer (1985) fait sommairement le tour de la question en contrastant l'étudiant comme tabula rasa ou comme agent actif d'hypothèses concernant son monde, contraste repris sous un autre angle en termes de nativisme vs. constructivisme. Une perspective relativement récente, issue de la psychologie cognitive et davantage pratique que théorique, considère l'apprentisasge comme le passage d'un état de novice dans un domaine à celui d'expert. Une analyse théorique de ce passage est offerte par Andersen (1983) qui considère le raffinement d'habilités (cognitives ou autres) comme procédant d'un processus de compilation de connaissances (par analogie avec l'emploi du terme en informatique). Sa théorie implique une distinction (laquelle fut sujette à un débat célèbre en IA) entre connaissances déclaratives et connaissances procédurales. Cette distinction est vite apparente dès qu'on procède à une analyse des objectifs d'apprentissage dans un domaine quelconque et soulève le problème délicat de l'articulation entre l'apprentissage d'habiletés et l'apprentissage conceptuel (Lesgold, 1982).

Un élément majeur du processus d'apprentissage est la motivation de l'étudiant, malgré que cet élément soit peu traité par les théories générales de l'apprentissage, sauf pour la théorie behavioriste, où elle joue un rôle déterminant mais considéré comme étroit depuis que le paradigme psychologique est passé au cognitivisme. La motivation, même si elle demeure encore imprécise au niveau théorique (Malone, 1981), exerce une influence pratique considérable dans le développement pédagogique (e.g., dans l'extension que connaît l'apport ludique en APO sous forme de jeux éducatifs). L'influence de cet apport est évidente dans les considérations pédagogiques qui sous-tendent des efforts récents en EIAO: Brown (1983), en effet, considère qu'une tâche d'apprentissage doit captiver l'intérêt de l'étudiant de façon constante et non lui être imposée de façon externe, comme c'est hélas trop souvent le cas.

Cette orientation pédagogique reflète un courant philosophique profond qui, partant de Dewey et passant par Piaget, par l'école ouverte et active, par Papert et bien d'autres, se retrouve en APO dans le concept d'environnement réactif (que ce soit de façon très ouverte, comme en LOGO ou encore de façon plus circonscrite, comme dans SOPHIE).

Un environnement réactif en est un qui possède les moyens de réagir avec un feedback approprié aux actions de l'étudiant sans que celles-ci soient nécessairement très fortement guidées par le système.

Cette orientation est menée à son ultime en APO dans le concept d'environnement créatif ("empowering environments" — Brown, 1985), où l'ordinateur est perçu comme un instrument créatif pouvant accroître l'apprentissage métacognitif de l'usager en lui reflétant ses processus cognitifs (Brown, 1985) ou pouvant même influer sur ses systèmes symboliques (Dickson, 1985).

Ce modèle d'apprentissage contraste de façon frappante avec le modèle pédagogique sur lequel repose l'EAO traditionnel. Au coeur de la question est cette notion de flexibilité plus ou moins grande à incorporer à un système, d'où une plus ou moins grande initiative de l'étudiant dans le déroulement d'une session d'apprentissage. Comme indiqué précédemment, il s'agit là d'un thème de recherche très actuel en EIAO, ainsi qu'en recherche pédagogique de façon générale.

Tendances actuelles en APO

Les APO sont un domaine vaste et diversifié où la généralité de l'ordinateur et la créativité des concepteurs pédagogiques sont mis à profit dans la réalisation d'innombrables systèmes qui visent des objectifs très variés. L'EAO traditionnel, malgré qu'on puisse lui trouver certaines limitations, demeure fondé sur une philosophie pédagogique valable et sur une utilité pratique reconnue. Les systèmes développés au début de l'EAO (v.g., le système de Suppes [Suppes et Morningstar, 1972] pour la pratique des fonctions mathématiques de base) sont certes dépassés en termes de virtuosité technique, mais demeurent des ressources pédagogiques dont l'utilité pourrait être tout aussi actuelle qu'il y a 20 ans.

Autrement dit, les styles d'APO peuvent changer, surtout de façon à profiter des capacités nouvelles introduites en informatique (v.g., le graphisme, l'ordinateur personnel, la rapidité de réponse, etc.), sans pour autant rendre inefficaces ou désuets les bons programmes antérieurs. L'élargissement technique que rendent possible les nouvelles technologies a pour effet plutôt d'étendre et de diversifier les applications possibles. Le traitement de texte en est un exemple frappant: il n'est pas appelé à remplacer les didacticiels de français, mais bien plutôt à être utilisé de façon complémentaire à ceux-ci.

Les nouveaux styles d'applications pédagogiques que l'on retrouve aujourd'hui (i.e., les tendances contemporaines, comprennent les jeux éducatifs) les environnements exploratoires, le vidéodisque interactif et les systèmes tutoriels intelligents. Certaines de celles-ci commencent déjà à être largement répandues, alors que d'autres demeurent encore relativement rares. Plusieurs exemples de ces applications émergentes en APO sont fournis par Lesgold (1982 et 1984).

Les jeux éducatifs. L'aspect ludique en APO sert essentiellement à maintenir l'intérêt de l'étudiant dans des tâches d'apprentissage à caractère répétitif, où le raffinement d'une habilité (v.g, en calcul) ou le développement de connaissances arbitraires (v.g., l'orthographe) requiert énormément de pratique cognitive qui a souvent peu d'attrait intrinsèque pour l'étudiant. Personne n'aime l'apprentissage par coeur (par exemple, apprendre une table de multiplication), mais cet apprentissage doit néanmoins être réalisé par chacun.

Les techniques de jeu créent des environnements attrayants dans lesquels des habiletés cognitives peuvent être suscitées et raffinées. L'ordinateur est en effet très apte à gérer tout un ensemble de variables qui peuvent intervenir dans un jeu, de même qu'enrichir considérablement les modalités d'interaction du joueur avec le jeu. Il importe cependant que les habiletés cognitives soient incorporées de façon efficace au je (i.e., que le jeu soit de fait éducatif et non uniquement une occasion ludique).

La puissance de l'aspect ludique en situation éducative en fait un élément très attrayant en pédagogie et il est très probable qu'il sera de plus en plus exploité dans tous les champs des APO. Son apport demeure surtout important, cependant, en situation où la tâche d'apprentissage éveille peu spontanément la curiosité épistémique de l'étudiant. Ces situations sont nombreuses, mais loin d'être universelles.

Les environnements exploratoires. L'ordinateur est une machine réactive: un input de l'usager, lorsque le programme est organisé pour l'interpréter, mène à une conséquence (i.e., une action du programme accompagnée d'un affichage rétroactif à l'écran). Il s'agit généralement (mais non toujours) d'une action symbolique (i.e., d'une action effectuée sur un modèle représentant une réalité extérieure). Il s'agit essentiellement d'une simulation, d'une situation où l'usager peut laisser libre cours à ses hypothèses cognitives en s'interrogeant effectivement sur leurs conséquences. Nous avons alors une situation où l'usager a le pouvoir d'expérimenter librement avec ses hypothèses sans pour autant avoir à en assumer les conséquences. C'est cette capacité de simulation aisée que veulent rendre disponible à l'usager les environnements exploratoires, que ce soit en création structurée (v.g., dans le logiciel Rocky's Boots pour la modélisation logique) ou en simulation scientifique.

Les possibilités pédagogiques de cette capacité d'exploration, se fondant sur une philosophie éducative qui valorise surtout l'étudiant comme agent actif dans l'apprentissage, sont puissantes car elles stimulent constamment la curiosité naturelle de l'étudiant. La structuration de ces environnements est très variée selon le domaine d'application. Certains environnements constituent des boîtes à outils cognitifs d'usage très général (v.g., les applications traditionnelles de simulation), d'autres constituent des ressources pédagogiques plus orientées (v.g., un laboratoire de chimie ou d'électronique) où des exercices spécifiques de découverte guidée peuvent être proposés (SOPHIE en est un bel exemple).

Le design de tels environnements exploratoires demeure une tâche délicate, car le niveau de structuration (l'ampleur de l'orientation à incorporer au système) et les moyens d'interaction étudiant-machine doivent être soigneusement considérés.

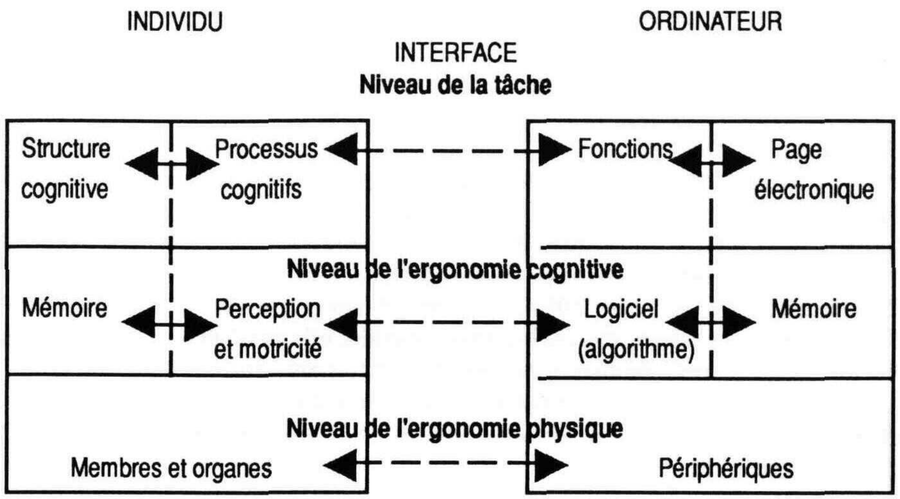
C'est dans cet esprit que Gagné (1987) proposait le modèle suivant pour aider à structurer les éléments de ces environnements (voir Figure 1).

Le modèle tente d'illustrer les différents niveaux à considérer dans l'étude d'une interaction élève-ordinateur. Le niveau de base est celui de l'ergonomie physique, se rapportant aux relations entre le corps de l'individu (ses membres, ses organes de perception) et les dispositifs d'entrée-sortie de la machine. Le niveau intermédiaire est celui de l'ergonomie cognitive ou du traitement de l'information par la perception et la mémoire humaine et de leurs équivalents dans la machine. Le niveau supérieur, celui de la tâche ou de l'apprentissage, met en relation la structure cognitive de l'individu et les processus mentaux qui permettent de structurer celle-ci et la page électronique de la machine qui permet de manipuler l'information.

Le vidéodisque interactif. Le vidéodisque en soi est une nouvelle technologie visuelle non-informatique. Cependant, couplé à un système informatique, il ajoute à celui-ci le pouvoir d'une banque énorme d'images et de séquences filmées pour rehausser le contact de l'étudiant avec les objets de connaissances. Il ajoute à la représentation symbolique (et généralement verbale) de la situaiton d'apprentissage une représentation parallèle de forme iconique.

Cette capacité visuelle permet de concrétiser les objets de connaissances, avec ce que cela implique d'avantages pratiques lors de l'apprentissage.

Figure 1. *Modèle d'un environnement d'apprentissage informatisé.*



Plusieurs tâches d'apprentissage requièrent en effet un contact soit direct, soit visuel (et non plus uniquement conceptuel) avec les objets de connaissances (v.g., tout ce qui a trait à l'identification, par exemple en biologie, en physique, et de façon générale dans le monde qui nous entoure). De plus, le développement cognitif de l'enfant n'amène que relativement tard et de façon graduelle la capacité pour celui-ci de jouer avec des opérations formelles de type abstrait, d'où la nécessité d'un soutien du concret en apprentissage aux niveaux primaire et secondaire dans plusieurs domaines.

Le vidéodisque interactif incorpore donc aux APO une capacité iconique. Il n'est pas en soi informatique et son succès pratique dépendra directement des applications informatiques dans lesquelles il sera intégré. Celles-ci peuvent être très variées, comme laisse l'entrevoir l'utilisation d'images dans des ressources didactiques traditionnelles (v.g., le livre, le film, etc). Malgré certaines difficultés pratiques actuelles, comme une relative rigidité au niveau de la production ou encore le coût d'appareillage, et malgré la compétition qui lui sera faite par les développements en graphisme numérique, le vidéodisque interactif s'annonce déjà comme un domaine prometteur en APO.

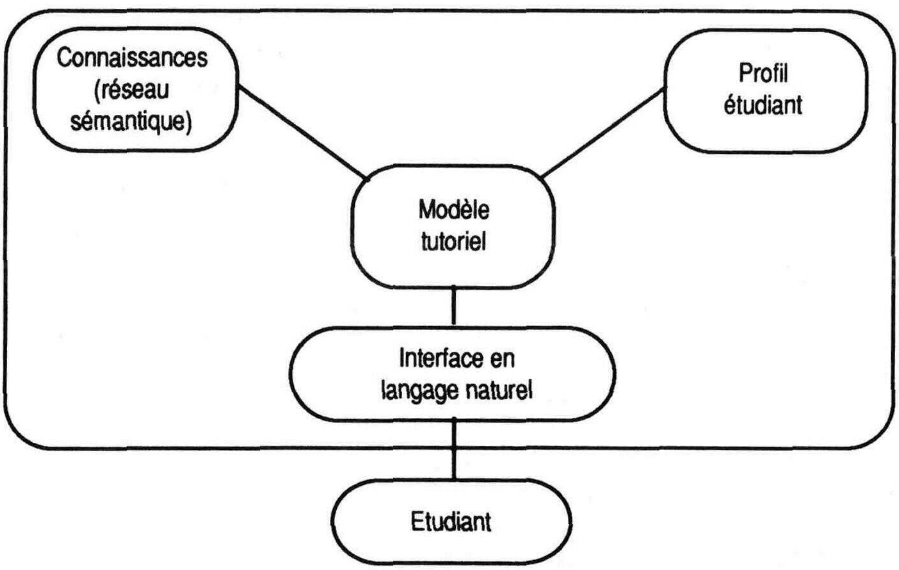
Les systèmes tutoriels intelligents. Il a déjà été fait mention des caractéristiques de l'IA de façon générale et de l'EIAO de façon plus particulière. Les systèmes tutoriels intelligents (STI) forment une sous-classe de l'EIAO. Leur but est de fournir à l'étudiant une interaction pédagogique similaire à celle qui pourrait lui être fournie par un tuteur humain. Cette capacité est loin d'être facile à atteindre, le tutorat étant généralement considéré comme étant la forme d'instruction la plus efficace possible (mais hélas la plus coûteuse également). De plus, les besoins techniques des STI, en termes de sophistication informatique et d'appareillage, font en sorte qu'ils ne constituent pas à l'heure actuelle une application pratique en APO. Les STI existants sont en effet presque tous des prototypes expérimentaux et ne sont guère utilisés en enseignement de façon pratique.

Le rôle d'un STI est de guider le cheminement cognitif de l'étudiant dans son exploration d'un domaine particulier. Dans certains cas, le domaine est surtout de type déclaratif v.g. la géographie (SCHOLAR), ou la météorologie (WHY); dans la plupart des STI cependant le domaine est davantage procédural (quoique non exclusivement), v.g. le diagnostic électronique (SOPHIE), médical (GUIDON), technique (STEAMER), la résolution de problèmes en algèbre (LMS), en arithmétique (WEST), en géométrie (GEOMETRYTUTOR), en électricité (OHM), la programmation (LISP TUTOR, PROUST, MENO TUTOR), etc. (voir Wenger, 1987, pour une description de ces systèmes).

Quoique la structure des STI est très variée, elle peut être représentée de façon générale comme comportant les éléments suivants:

Deux tâches principales guident l'opération d'un STI: diagnostiquer les problèmes de l'étudiant et orienter la démarche de l'étudiant pour pouvoir y remédier. Le diagnostic se fait essentiellement en analysant la démarche de l'étudiant (la comparant à une démarche experte, ou à tout le moins à une démarche appropriée) de sorte à caractériser l'étudiant en termes de connaissances ou d'habiletés déficientes. La stratégie tutorielle du système doit par la

Figure 2. *Structure d'un STI.*



suite déterminer quand et comment intervenir dans le processus d'apprentissage pour réorienter la démarche de l'étudiant. Il s'agit globalement du modèle socratique du dialogue tutoriel (Collins et al. 1975).

Comme indiqué précédemment, le problème délicat pour tout STI est celui de déterminer la façon appropriée d'intervenir (le faire efficacement, mais sans s'imposer au cheminement cognitif, lui-même délicat, de l'étudiant). Pour cela, un STI doit comprendre et garder à jour plusieurs modèles sophistiqués: un modèle du domaine (de l'expertise à enseigner), un modèle de l'étudiant (en évolution constante), et un modèle de l'acte tutoriel (sous forme de stratégies pédagogiques précises). La sophistication requise dans chaque cas font des STI un champ très actif et très prometteur d'expérimentation en psychologie éducative.

Les quatre grandes tendances en APO décrites dans cette section ont été présentées de façon indépendante l'une de l'autre. Il serait erronné de considérer le futur des APO de cette façon, cependant. En effet, les quatre grands thèmes décrits peuvent être avantageusement considérés comme des aspects pédagogiques et informatiques des APO, plutôt que comme des catégories de ceux-ci. Les recoupements sont évidents: le vidéodisque interactif, par exemple, sera intégré à une forme ou l'autre d'EAO, que ce soit à un didacticiel de type classique ou à un STI; par ailleurs, certains STI sont incorporés à des situations de jeux éducatifs, v.g. WEST et WUSOR (voir Wenger, 1987).

De fait, l'IA en tant qu'ensemble de techniques informatiques diverses, est appelé à jouer un rôle majeur dans tout développement futur en APO. Il servira alors à étendre la puissance des moyens traditionnels et des formes d'APO en émergence.

PROSPECTIVE

Que seront les APO dans cinq ans d'ici? L'informatique contemporaine est un domaine en évolution rapide; cela est surtout vrai en intelligence artificielle et en micro-informatique, domaines qui connaissent un intérêt marqué depuis quelques années. Face à l'esprit d'innovation qui imprègne la recherche-développement en informatique appliquée, il est certes difficile de faire un pronostic sur le développement des APO au cours des cinq prochaines années. Il y a donc lieu d'être spéculatif.

Les approches et les techniques d'aujourd'hui seront probablement encore courantes, quoique raffinées et amplifiées, et de nouvelles s'y ajouteront. De nouvelles applications étendront certainement la gamme des utilisations actuelles, car c'est après tout vers une société de plus en plus impliquée en informatique que nous nous dirigeons.

La perspective actuelle permet d'entrevoir certaines prospectives potentielles, qui sont présentées à titre indicatif ci-dessous.

Une certaine maturité d'exploitation. Le fameux virage technologique a réussi à intéresser le monde de l'éducation aux APO et nombreux sont ceux qui s'y sont lancés non seulement en tant que simples utilisateurs, mais en tant que développeurs également. Cette énergie créatrice a mené à des réalisations importantes, mais souvent de qualité fort inégale. Nous doutons cependant qu'une déception généralisable s'installe dans le monde de l'éducation comme ce fut le cas pour d'autres technologies éducatives. L'ordinateur est trop universel et trop ouvert à des applications intéressantes nouvelles pour qu'il soit négligé. Une maturité d'utilisation, surtout en ce qui concerne l'évaluation des APO, est plus probable: les produits de qualité moindre seront oubliés au profit de leurs concurrents plus sérieux. Dans cinq ans, les APO seront donc probablement d'un intérêt tout aussi actuel qu'aujourd'hui.

Une reconfiguration au niveau de l'appareillage. Malgré son développement fulgurant récent, la micro-informatique est appelée à se transformer. D'une part, les appareils qui sont introduits présentement dans les écoles sont trop peu puissants pour soutenir les applications les plus intéressantes de demain; d'autre part, ces appareils sont limités en termes d'interface étudiant-machine. D'ici cinq ans,ces appareils seront désuets.

L'utilisateur de demain interagira avec un appareil puissant au moyen d'une interface flexible et sera branché en réseau avec d'autres appareils, dont de très puissants. Les limitations actuelles au niveau de la puissance informatique et du style d'interaction seront abolies en faveur d'une utilisation aisée et sophistiquée. Les innovations dans ce domaine étendront le concept d'utilisation pratique de l'informatique en éliminant les barrières techniques à cette utilisation.

Une informatique intelligente. C'est une thèse centrale de cet article que l'avenir de l'informatique passera par l'intelligence artificielle. Les APO constituent des applications surtout symboliques de l'informatique et profiteront de ce fait des nouveaux moyens en développement en IA. D'ici peu, il est à prévoir que les meilleurs produits en APO incorporeront des éléments d'IA dans leur structure et dans leur fonctionnement. Le dépassement des limitations actuelles au niveau de l'appareillage permettront de façon courante certaines applications qui aujourd'hui ne jouissent que du statut de prototype de recherche.

Ce n'est pas dire cependant que toute APO de demain sera nécessairement sophistiquée, car la psychologie éducative et cognitive est loin encore d'avoir proposé des solutions miracles. Ce qui ressort clairement de la recherche actuelle en EIAO, où une opérationnalisation stricte est de rigueur, c'est bien toute l'imprécision de nos théories didactiques, et la complexité cognitive d'un apprentissage sophistiqué. Les systèmes tutoriels intelligents requièrent une théorie du tutorat et à l'heure actuelle, cela relève avant tout d'une approche ad hoc, le domaine étant encore si peu développé (mais dans un état d'effervescence certaine). Une telle théorie, laquelle résultera d'une expérimentation continue dans le design de systèmes d'EIAO, constitue le besoin le plus important pour la recherche à long terme en APO (voir à cet effet Greeno, 1986).

La prospective présentée dans cette section peut paraître à certains comme étant plus futuriste que réalisable d'ici cinq ans. Nous ne le croyons pas, cependant, et cela pour les raisons suivantes:

1) des sommes massives sont investies par plusieurs pays actuellement en R & D informatique (v.g., les programmes Alvey, ESPRIT, ICOT, Stratégie Computing Initiative);

2) les applications de l'ordinateur en général (et les APO en particulier), ainsi que les nouveautés d'appareillage, jouissent d'un climat commercial extrêmement compétitif qui récompense les percées technologiques; et

3) le pouvoir potentiel de l'ordinateur accroît constamment l'intérêt qu'y portent les chercheurs en psychologie cognitive appliquée, y compris la psychologie éducative.

Ces facteurs présagent d'un avenir des plus fascinants pour les APO et il importe que nous nous insérions de façon importante dans la R & D de pointe dans ce domaine.

RÉFÉRENCES

Anderson, J. R. (1983). *The architecture ofcognition.* Cambridge, MA: Harvard University Press.

Brown, J. S. (1983). Learning by doing revisited for electronic learning environments. In M.A, White (Ed.), *The future of electronic learning.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Brown, J. S. (1985). Process versus product: A perspective on tools for communal and informai electronic learning. *Journal of Educational Computing Research, 1*,179-201.

Brown, J. S., Burton, R., & De Kleer, J. (1982). Pedagogical, natural language and knowledge engineering techniques in SOPHIE I, II and III. In D. Sleeman & J.S. Brown (Eds.), *Intelligent tutoring Systems* (pp. 227-282). New York, NY: Académie Press.

Bruner, J. S. *(l982).Towardatheoryofinstruction.* Cambridge, MA: Harvard University Press.

Bruner, J. (1985). Models of the learner. *Educational Researcher, 14,* (6), 5-8.

Burton, R. (1982). Diagnosingbugs in a simple procédural skill. In D. Sleeman & J.S. Brown (Eds.). *Intelligent tutoring Systems* (pp. 157-184). New York: Académie Press.

Carbonell, J. (1970). AI in CAI: An artificiel intelligence approach to computer assisted instruction. *IEEE transactions on man-machine Systems, 11* (4), 190-202.

Clancey, W. (1982). Tutoring rules for guiding a case method dialogue. In D. Sleeman & J.S. Brown (Eds.), *Intelligent tutoring Systems* (pp. 201-226). New York: Académie Press.

Collins, A., Warnock, E., & Passafiume, J. (1975). Analysis and synthesis of tutorial dialogues. In G. Bower (Ed.), *The psychology of learning and motivation, 9,* 49-87.

Davis, R., & Lenat, D. (1982). *Knowledge-based systems in artificial intelligence.* New York, NY: McGraw-Hill.

Dickson, P. (1985). Thought-provoking software: Juxtaposing symbol systems. *Educational Researcher, 14* (5), 30-38.

Duchastel, P. (1986a). Approches p^dagogiques en EIAO. Dans J. Vasquez-Abad & J.Y. Lescop (Eds.). *La technologie educative et le developpement humain.* Montreal, PQ: Te^-Universite, 35-43.

Duchastel, P. (1986b). Learner control in ICAI. *Journal of Educational Computing Research 2,* 379-393.

Duchastel, P., & Imbeau, J. (1986). Strategies tutorielles en EIAO. *Actes du 5e symposium canadien sur la technologie pedagogique,* Ottawa, ON: CNRC, 89-94.

Gagne, P. (1987). L'utilisation des progiciels dans 1'enseignement. Conference presentee au 6e colloque du CIPTE, *Communication et technologie educative,* Orford, Canada.

Greeno, J. (1986). Advancing cognitive science through development of advanced instructional systems. *Machine-Mediated Learning, 1,* 327-343.

Kurland, M.D. (1983). Software for the classroom: Issues in the design of effective software tools. In *Chameleon in the classroom: Developing roles for the computer,* Technical report no 22, Bank Street College of Education, New York.

Lesgold, A. (1982). *Paradigms for computer-based education.* Pittsburg, PA: Learning Research and Development Center, University of Pittsburgh.

Lesgold, A., & Lesgold, S. (1984). *Classroom computers and state curriculum policy*. Pittsburg, PA: Learning Research and Development Center, University of Pittsburgh.

O'Shea, T., & Self, J. (1983). *Learning and teaching with computers - artificial intelligence in education.* Brighton: Harvester Press.

Schwartz, J. (1984), *Educational software: Contrasting realizable mediocrity, unreasonable idealism and realizable excellence.* Presentation au congres L'ordinateur et l'6ducation, Montreal.

Sheingold,K(1984). *The microcomputer as a medium for young children.* New York, NY: Center for Children and Technology, Bank Street College of Education .

Sleeman, D. & Brown, J.S. (1982). *Intelligent tutoring systems.* New York, NY: Academic Press.

Suppes, P. & Morningstar, M. (1972). *Computer-assisted instruction at Stanford, 1966-68; Data, models and evaluation of the arithmetic programs.* New York, NY: Academic Press.

Wenger, E. (1987). *Artificial intelligence and tutoring systems.* Los Altos, CA: Morgan Kaufmann.

AUTHORS

Philipe Duchastel et Pierre Pelletier sont professeurs en technologic educative a I'Universite Laval, a Quebec. Le professeur Duchastel fit ses Etudes & Florida State University; il dirige actuellement un laboratoire de recherche en intelligence artificielle applique"e & 1'education. Le professeur Pelletier fit ses Etudes au University of Southern California; il dirige actuellement un projet de recherche centre' sur 1'utilisation de progiciels en Education. Us peuvent etre contactes au de"partement de Technologic de 1'enseignement, 1466, pavilion Charles De Koninck, Universite Laval, Quebec, G1K 7P4.

CALL FOR PAPERS

The Canadian Journal of Educational Communication

invites papers in the area of:

Interactive Learning Technologies

to be published in a special issue devoted to this topic in the Fall of 1989. Topics within this area may include, but are not limited to: computer-aided learning; interactive video; intelligent tutoring systems; hyper-media (e.g., HyperCard); expert advisory systems; telecommunications; computer conferencing; and smart systems.

Papers may take the form of reviews of literature, descriptions of approaches or procedures, descriptions of new applications, theoretical discussions or reports of research. For details on the preparation and submission of manuscripts, please refer to *Information for Authors* on the inside back cover of this or any issue of *CJEC*. Except in unusual cases, manuscript length should not exceed 20 pages. All manuscripts received by the editor will be reviewed by a panel of judges.

Please address all enquiries or manuscripts to:

Dr. Richard A. Schwier
CJEC Guest Editor
College of Education
University of Saskatchewan
Saskatoon, SK S7N OWO
(306) 966-7641

The Effect of Interaction and Perceived Need for Training on Learning and Time Spent Learning from Computer-Based Instruction

Richard A. Schwier
Earl R. Misanchuk

Abstract: Commonly, computer-based Instruction (CBI) Is designed to expose learners to a series of instructional frames, followed periodically by inserted questions to reinforce learning. The practice is so widespread that the efficacy of such an approach is seldom questioned. This study examined whether covert or overt strategies were effective and efficient methods of stimulating interaction in CBI, and whether the effectiveness and efficiency of embedded strategies are modified by the perceived need for training of learners. Results indicated that learners with high perceived need for training found embedded questions which required structured overt responses to be more effective and efficient than competing treatments. Learners with low perceived need for training, however, achieved similar amounts of learning from all treatments offered, but found a treatment without embedded strategies (questions or review frames) to be the most efficient treatment offered.

An ample and growing body of evidence supports the use of computer assisted instruction as a technology of instruction. CBI applications compare favorably to other methods of instruction across a variety of subjects, modes, and grade levels on measures of learning and time (Edwards, Norton, Taylor, Weiss & Dusseldorp, 1975; Kulik, Bangert & Williams, 1983; Kulik, Kulik & Cohen, 1980). That CBI can be effective is interesting, per se, but it also begs the question "why?" Clark (1985) has argued that achievement gains often found in CBI studies may, in fact, be attributable to "uncontrolled but robust methods embedded in CBI treatments" (p. 249). In other words, CBI's observed effectiveness may be more a product of the care that went into the design of the instruction than of the medium itself. At the same time, the call has been out for some time now for research that investigates the unique contribution made to learning effectiveness by the interaction of learner and communication medium variables (e.g., see Clark, 1983). Restated, what design and learner variables interact with the medium to promote or inhibit its effectiveness?

Learner Interaction

From the time of research into programmed instruction in the 1960's, requiring the learner to respond meaningfully to the instruction has been accepted in both theory and practice. Effective learners actively interact mentally during instruction, suggesting that both attention and manipulation of information can improve information acquisition and retrieval (Bransford, 1979; Dwyer & Dwyer, 1987), and instructional designers are exhorted to provide for meaningful interaction in order to produce effective instruction (e.g., see Markle, 1978). Providing the learner with opportunities to rehearse or practice using information likely stimulates the attention and manipulation activities desired. Meaningful rehearsal also increases the likelihood that information will be transferred from short-term to long-term memory (Dwyer & Dwyer, 1987).[1]

A variety of interventions have been suggested to accomplish covert and overt learner interaction with instruction. Researchers searching for robust methods for stimulating interaction have employed devices such as adjunct questions (Dayton & Schwier, 1979), mnemonic devices (Atkinson, 1975), images and verbal contextual organizers (Bernard, Petersen & Ally, 1981), and illustrations (Duchastel, 1980). At the heart of most studies is the notion of learner activity or interaction. Rothkopf (1970) used the term "mathemagenic" to refer to those activities of the learner which produce learning. Thus, mathemagenic activities mediate the nominal stimulus (the stimulus as presented) and the functional stimulus (the stimulus as perceived by the learner) to shape learning (Underwood, 1963). It can be expected, on these bases, that with CBI, requiring learner interaction should lead to greater learning.

Overt and Covert Activity

In experiments, overt activities such as test-like events are often used because of the difficulty of measuring the amount or quality of mental activity devoted to instruction covertly. A motivated learner may impose aggressive mental activity on instruction, such as developing analogies, creating mnemonic devices, mentally practicing material, and testing personal assumptions. Certainly, this type of covert mathemagenic activity may result in increased learning. Another learner may adopt a passive posture, casually drift through instruction, and exhibit poorer performance. The differing quality of activity is difficult to measure, and usually remains unseen by the researcher.

On the other hand, overt activities can be observed, and may force attention to and interaction with information. Learners who are otherwise passive can be challenged to examine their understanding and modify their approaches to instruction. This assumes a modest level of coercion; the learner must interact with instruction regardless of the need for interaction. Perhaps it can be assumed that such intervention will help most students, and will serve as a placebo reinforcement for others who are covertly active. But, is it

[1] This discussion refers to the literature on levels of processing, an established concept in cognitive psychology. The reader may wish to refer to Craik and Lockhart (1972) and Craik and Watkins (1973) for elaboration.

possible that this organized imposition could interfere with covert strategies that motivated learners already bring to instruction? For example, will a learner who covertly develops an analogy to explain a particular construct find an externally imposed analogy distracting?

Computer based instruction offers developers a wide range of opportunities to impose covert and overt mathemagenic strategies on learners. Theoretical explanations for mathemagenic behaviours include learner-active constructs such as forward shaping and internal processing (Boyd, 1973; McConkie, Rayner & Wilson, 1973), and learner-passive constructs such as additional review or exposure to instruction (McGaw & Grotelueschen, 1972; Rickards & DiVesta, 1974; Yost, Avila & Vexler, 1977). Most studies have ignored these competing explanations for increased learning. One purpose of this study, therefore, was to examine whether an overt strategy, in this case embedded questions, facilitates learning to a greater extent than a covert strategy, in the form of review or summary frames which provides redundant information. In other words, if additional learning occurs with CBI which contains mathemagenic strategies, is it the result of additional exposure to content, or can it be explained by the active role of the learner in the instructional process?

Given the above discussion on the reputed importance of interactivity in fostering learning and the potentially different quality of overt versus covert strategies, it is reasonable to hypothesize that embedded questions (being overt and requiring interaction) will produce more learning than will covert strategies. Further, since review frames can be viewed as offering opportunities for (but not requiring) additional cognitive processing, it may be hypothesized that the inclusion of review frames will allow for greater reflection, and therefore learning, than CBI without such frames.

Perceived Need for Training

Given the vast literature showing the effects of motivation on learning, we speculate that different learners might naturally invest differently in the instruction, based upon their motivation to acquire the knowledge. In other words, as learners' perceptions of their need to learn vary, so might the amount of covert activity brought to bear on the instruction. Schwier (1986) speculated that learners' perceived need for training could interact with different instructional treatments to influence learning outcomes. A trivariate model of instructional need proposed by Misanchuk (1984a) was used in this study to determine the learners' perceived need for training. The model suggests that instructional need, under various circumstances, could be viewed as a function of the learners' perception of the relevance (R) of the instruction, the individual's extant competence (C) in the task or skill to be taught, and the desire (D) to take training on the subject.

Learning Time

CBI typically relinquishes control of time spent on instruction to the learner, and functionally, a learner could dramatically influence the amount of time spent on instruction. Embedded questions or review frames interspersed throughout instruction might also serve to increase the total amount of time a particular learner spends on instruction. Does the increased time required to respond to questions or read review frames produce sufficient additional learning to justify the additional time devoted to instruction? Perhaps more is learned, but at the expense of time which could be devoted to other learning Opportunities. Dayton and Schwier (1979) found that exposure to adjunct questions impaired incidental learning efficiency. Their findings were related only to fixed-pace, fixed-sequence media, however, and cannot necessarily be generalized to CBI, which allows a greater degree of learner control. We speculate that an interactive medium which permits a high degree of learner control may also introduce the possibility of an increase in learning time.

HYPOTHESES

1) Performance on learning measures will reveal a hierarchical relationship among treatments such that CBI with questions will be superior to CBI with review frames, and both will be superior to the control group receiving just CBI.

2) Learners with high perceived need for training will exhibit superior performance on learning measures than will learners with low perceived need for training.

METHODOLOGY

Treatments

Three parallel content versions of experimental and control treatments were developed, employing approximately four hours of computer-based training on the topic of financial management for supermarket managers. The instruction introduced learners to the terminology of financial management, and how to analyze and interpret a charge gross report and store operating statement. Content and examples specifically referred to the financial operation of the corporation which employed the *high need* group subjects, but dealt with concepts which had general application in business finance. Experimental treatment #1 (CBI + Q) included embedded post-questions inserted throughout the instruction,[2] and feedback to the learner's response to the question. Experimental treatment #2 (CBI + R) included review frames which summarized or reiterated the content treated by the embedded post-questions in the CBI + Q treatment. A control treatment (CBI) was developed which

'The questions were of the type that might serve as review questions following a segment of instruction, but were actually inserted in various locations close to, but following, their referents.

contained the same content but neither embedded post-questions nor review frames.

Experimental and control treatments contained identical menu and instructional structures, save the question and review frames offered in the experimental treatments. In all treatments, the subject determined the order and amount of time spent on various components of instruction.

All treatments were compatible with MS-DOS based microcomputers, and were primarily textual with modest graphics. Although the instruction was designed to be used with either colour or monochrome systems, all subjects received the treatment on monochrome displays. Typically, subjects required approximately four hours to complete the instruction, although time on task varied considerably among subjects.

Subjects

High-need subjects (n = 18) were recruited from among assistant managers and department managers for a large food store chain in the southeastern United States. As a check on the assumption that these subjects had high need for training, each subject completed a needs assessment instrument. It was suspected that job role might influence scores, so each group was matched according to job role (assistant managers, department managers). Beyond this, assignment to treatments was random.

Low-need subjects (re = 18) were recruited from a management training course at the University of Saskatchewan, under the assumption that subjects not employed in supermarket management would exhibit significantly lower perceived need for training than those in the high-need group. The same needs assessment instrument was administered to test this assumption.

Measures

Needs data were collected using a questionnaire which asked subjects to rate the perceived relevance (How relevant is this item to someone who does your job?), competence (How knowledgeable or skilled are you in this item?) and desire (How motivated are you to undertake training on this item?) of the ten major topics in the CBI program *(see Figure 1 on following page).* Average scores for each of relevance, competence and desire were computed for the high-need and low-need groups *(See Table 1 on next page).*

The measure of learning consisted of sixty knowledge and application level items constructed from the objectives for the instruction. All of the items were novel; they did not appear as embedded questions in the CBI + Q treatment. Twenty questions were administered to subjects following their completion of each of the three units of instruction. Fifteen items were presented on the computer and five were written on an accompanying handout. It was discovered only after the first group was tested that the program stored only total scores and not item scores, so an estimate of the reliability of the measure could not be made.

The total instructional time was recorded by subjects following each unit. This was monitored by a research assistant, to ensure that time was faithfully registered by subjects during instruction.

Figure 1. ***Sample*** *of Training Needs Questionnaire.*

en

COMPUTER-BASED TRAINING FIELD TEST NEEDS ASSESSMENT

Instructions: A list of items appears below concerning financial management in retail groceries. Rate each item in terms of its **Relevance** to someone in your position, your **Competence** in performing that item, **Desire** to take training on that item. **Circle the numbers which are appropriate, and fill out the form completely.**

	Relevance How relevant is this item to someone who does your job? 1. Highly relevant 2. Relevant 3. Useful, but not important 4. Not very useful 5. Irrelevant	***Competence*** How knowledgeable or skilled are you in this item? 1. Highly competent 2. Competent 3. Somewhat competent 4. Not very competent 5. No competence	***Desire*** How motivated are you to undertake training on this item? 1. Highly motivated 2. Motivated 3. Somewhat motivated 4. Ambivalent 5. Would rather not participate
1. Basic financial management terms and definitions	*1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5
2. Major principles of financial management	*1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5
3. Familiarization with financial management documents	*1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5
4. Basic business mathematics	*1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5
5. Terms and definitions on the Charge Gross Report	*1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5

Procedure

Subjects were first asked to complete the needs questionnaire, after which they were assigned to a computer, and given instructions on how to record scores and time for each unit. Each was first exposed to an introductory unit which introduced the CBI program, and was given the information needed to use the microcomputer. This permitted a standardized set of instructions and also accommodated settling behaviours.

Each subject then completed the CBI individually; the research assistant ensured that the same protocol was followed by all subjects.

Experimental Design and Analysis

The design employed was a 2 x 3 factorial analysis of variance. The independent variables were perceived need for training (high.low) and treatment (CBI + Q, CBI + R, CBI). The assumption regarding the classification of perceived need for training was checked by performing £-tests on the average scores for both need groups for each of the relevance, competence, and desire scales.

As is almost customary in CBI studies, the dependent variables were achievement (as measured by an achievement test) and time to complete instruction.

RESULTS

Check on Assumptions Regarding Need for Training

The data confirmed the assumption that the high-need subjects did in fact have a higher perceived need for training, in terms of two of the three components of the RCD model, than did the low-need subjects. Mean scores for the two groups on the three components are shown in Table 1. One-tailed t-tests showed that all three differences are significant.

For complete fidelity to the RCD model, the high-need group would have

TABLE 1
Average Scores for Relevance, Competence, and Desire for High-Need and Low-Need Subjects

	Average Scores		
Component of Need	Low Need	High Need	
Relevance	3.23	1.50	- 5.98*
Competencet	3.64	2.51	- 4.28*
Desire	2.83	1.60	- 4.42*

*p < 0.0001, one-tailed test
t Scale descriptors are such that a high score indicates low competence.

needed to demonstrate equal or inferior competence in comparison to the low-need group, yet they did the opposite. In light of the reality of the experiment, this should not be surprising, since the subjects in the high-need group were already in job roles that used many concepts and procedures similar to the ones that were being taught in the instructional treatment.

Inasmuch as a) the RCD model was employed only to check an assumption, b) the three components of need for training are normally weighted as equally important (Misanchuk, 1984b), and c) two of the three components of the model matched the direction predicted by the model, with the deviant one being the weakest of the three (in terms of magnitude of *t*), the assumption of differences between the two groups with respect to need for training was deemed confirmed.

The data related to learning performance were subjected to two-way analyses of variance, using achievement and time, in turn, as dependent variables.

Achievement

With achievement as the dependent variable, the analysis of variance showed that neither perceived need for training nor question treatment had a significant effect (see Table 2). However, there was a significant effect for the interaction of the two variables ($F = 5.08$, $p = .013$).

TABLE 2
Analysis of Variance with Achievement as the Dependent Variable

Source	*df*	*SS*	*MS*	*F*	*p*
Motivation (A)	1	13.44	13.44	.24	.62
Treatment (B)	2	276.17	138.08	2.54	.10
A x B	2	552.06	276.03	5.08	.01
Error	30	1629.33	54.31		

Inspection of the cell means (see Table 3 next page) showed that the high-need group under the inserted questions treatment condition had substantially higher achievement than learners under other conditions. A Newman-Keuls test revealed that the mean for the high need/inserted questions condition was significantly higher than all other means ($p < .01$). In addition, the low need/control condition mean was significantly higher than the high need/control treatment condition mean ($p < .01$).

Time

With time as the dependent variable, the analysis of variance showed no significant effects ($F < 1.0$) (see Table 4).

TABLE 3
Means of Cells with Achievement as the Dependent Variable

	Treatment		
Need for Training	CBI + Q	CBI + R	CBI
High	51.7	39.2	36.5
Low	39.8	40.5	43.3

DISCUSSION

The results of this study led to the rejection of hypotheses 1 and 2, but revealed an interesting interaction between perceived need for training and treatments. These results support the notion that inserting questions periodically within CBI can increase achievement for individuals who have a high degree of perceived need for the knowledge and skills. The same did not hold true for individuals with lower levels of perceived need for training. For low-need individuals, these data would suggest that no embedded strategy is superior to another to enhance achievement.

TABLE 4
Analysis of Variance with Time as the Dependent Variable

Source	*df*	SS	*MS*	F	*P*
Motivation (A)	1	2070.25	2070.25	1.11	.30
Treatment (B)	2	10348.67	5174.33	2.79	.08
A x B	2	2660.67	1330.33	.72	.50
Error	30	55727.17	1857.57		

What light do these results shed on the controversy surrounding the use of embedded strategies in CBI? Since the amount of time taken to complete the instruction is not significantly different under any treatment condition, we can focus our attention solely on achievement. Embedded questions appear to offer advantages to learners with high perceived need for training and do not disadvantage learners with low perceived need for training. Perhaps learners with higher perceived need for training interact more aggressively with the questions, resulting in more cognitive activity and therefore a greater depth-of-processing.

One interesting finding was that the time-on-task for the control treatment did not differ significantly from the time-on-task for treatments with embedded questions or review frames, even though the control treatment had fewer frames. We offer two possible explanations that are speculative. First, individuals receiving the control treatment (no interaction) may have become bored and sluggish in response to the page-turning approach, and thus moved more slowly through the instruction. Second, it is possible that individuals introduced their own cognitive strategies to the instruction when they were not provided. These self-imposed strategies may have occupied as much time as reviewframes or embedded questions. We have no data to suggest a preference for either the "learner-active" or "learner-sedated" explanation, but we suggest that such a question deserves study.

More difficult to explain is the anomaly of the low-need learners performing significantly better than the high-need learners under the control treatment, and we present the finding merely as an observation.

Overall, the data suggested that the level of perceived need for training may be an influential mediator in CBI. Subjects in the high-need group experienced instruction which was specifically designed for their jobs, and the match between the content of instruction and perceived need for training may have influenced subjects' willingness to invest actively in structured opportunities for practice. The job-specificity of the content allowed the researchers to identify groups with different levels of perceived need for training. We are not able to comment on whether these results can be generalized to groups which have "closer" levels of perceived need for training, as is often found in traditional classrooms or training events. Future studies, however, might fruitfully examine a continuum of need levels to determine how sensitive achievement and efficiency of CBI treatments are to a continuum of perceived need for training.

REFERENCES

Atkinson, R. (1975). Mnemotechnics in second-language learning. *American Psychologist, 30,* 821-828.

Bernard, R.M., Petersen, C.H., & Ally, M. (1981). Can images provide contextual support for prose? *Educational Communication and Technology Journal,* 29(2), 101-108.

Boyd, W.M. (1973). Repeating questions in prose learning. *Journal of Educational Psychology, 64,* 31-38.

Bransford, J. (1979). *Human cognition: Learning, understanding, and remembering.* Belmont, CA: Wadsworth Publishing.

Clark, R. (1983). Reconsidering research on learning from media. *Review of Educational Research,* 53(4), 445-459.
Clark, R. (1985). Evidence for confounding in computer-based instruction studies: Analyzing the meta-analyses. *Educational Communication and Technology Journal,* 33(4), 249-262.
Craik, R, & Lockhart, R. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11,* 671-684.
Craik, R, & Watkins, M. (1973). The role of rehearsal in short-term memory. *Journal of Verbal Learning and Verbal Behavior, 12,* 599-607.
Dayton, D., & Schwier, R. (1979). The effect of inserted questions and individual differences on learning from fixed-pace, fixed- sequence media. *Educational Communication and Technology Journal, 27(2),* 103-113.
Duchastel, P. C. (1980). Research on illustrations in text: Issues and perspectives. *Educational Communication and Technology Journal, 28(4),* 283-287.
Dwyer, R, & Dwyer, C. (1987). *The effect of time as an instructional variable on students' ability to profit from visualized instruction.* Paper presented at the annual conference of the Association for Educational Communications and Technology, Atlanta, GA.
Edwards, J., Norton, S., Taylor, S., Weiss, M., & Dusseldorp, R. (1975). How effective is CAI? A review of the research. *Educational Leadership,* 33(2), 147-151.
Kulik, J., Bangert, R., & Williams, G. (1983). Effects of computer-based teaching on secondary school students. *Journal of Educational Psychology, 75(1),* 19-26.
Kulik, J., Kulik, C., & Cohen, P. (1980). Effectiveness of computer-based college teaching: A meta-analysis of findings. *Review of Educational Research, 50(4),* 525-544.
Markle, S. *(1978). Designs for Instructional Designers.* Champaign, IL: Stipes Publishing.
McConkie, G. W., Rayner, K., & Wilson, S. (1973). Experimental manipulation of reading strategies. *Journal of Educational Psychology, 65,* 1-8.
McGaw, B., & Grotelueschen, A. (1972). Direction of the effect of questions in prose material. *Journal of Educational Psychology, 63,* 580-588.
Misanchuk, E. R. (1984a). Analysis of multi-component educational and training needs. *Journal of Instructional Development,* 7(1), 28-33.
Misanchuk, E. R. (1984b). *The analysis of multi-component educational and training needs: The multivariate case.* Paper presented at the annual meeting of the Association of Educational Communications and Technology, Dallas, TX.
Rickards, J. P., & DiVesta, R J. (1974). Type and frequency of questions in processing textual material. *Journal of Educational Psychology, 66,* 354-362.
Rothkopf, E. (1970). The concept of mathemagenic activities. *Review of Educational Research, 40,* 325-336.

Schwier.R.A.(1986). Applying needs to instructional development: Extension of the R-C-D Model. *Canadian Journal of Educational Communication, 15(2),* 91-104.

Underwood, B. J. (1963). Stimulus selection in verbal learning. In C.N. Gofer & B.S. Musgrave *(Eds.). Verbal behavior and learning.* New York: McGraw-Hill.

Yost, M., Avila, L., & Vexler, E. (1977). Effect on learning of post-instructional responses to questions of differing degrees of complexity. *Journal of Educational Psychology, 69,* 399-408.

AUTHORS

Richard A. Schwier is a Professor and Earl R. Misanchuk is an Associate Professor in the Department of Communications, Continuing and Vocational Education, University of Saskatchewan, Saskatoon, SK, S7N OWO.

Profile

Research on Computer-Based Learning Environments: The Vitrine 2001

Laura R. Winer

Abstract: The Vitrine 2001 is a project devoted to the study of computer-based learning environments. *Computer-based* implies more than just the presence of a machine; in a true computer-based learning environment, the power of computers as tools which permit the creation and manipulation of information is exploited as much as possible. *Learning* environments because our primary concern is to create, for both students and teachers, environments which promote and facilitate learning. *Environment* includes all of the physical, cultural, human and computer components which may influence the user's activities.

The *Vitrine* project is working towards this vision of the future of educational computing and is based on the principle that children must be an integral part of the development process. Since March 1987, a team of researchers has been working with various groups of children from six to sixteen years of age to discover and create this future. The *Vitrine* was developed with the idea that computers could best be used in education to favour process learning over content, and as tools to facilitate communication and encourage creativity.

WHAT IS THE VITRINE 2001?

The Vitrine 2001 is a research project of the Quebec Centre for Research in Educational Computing (APO Quebec). APO Quebec is a non-profit Quebec government corporation promoting applied research and development in educational computing. It serves the entire educational system, from nursery school to university, including vocational and technical programmes. It also aids and advises private industry working in the microcomputer field.

The Vitrine 2001 is a computer-based learning environment; in other words, an environment which has as its goal facilitating learning and teaching by using computer and other associated technologies. The concept *ofenvironment* includes all of the physical, cultural, human and computer components which may influence the user's activities. These are *learning* environments because the primary focus is to create, for both students and teachers, environments which promote and facilitate learning. *Computer-based* implies more than just the presence of a machine; in a true computer-based learning environment, the power of computers as tools which permit the creation and manipulation of information is exploited as much as possible.

The project is distinguished by its pedagogical approach, which draws on both Piagetian and Brunerian learning theories as well as the concept of micro-worlds as elaborated by Papert (1980) and Brown (1985). The learner is the starting point: the learner's interests, competencies, strengths, and weak-nesses are the driving factors in how activities unfold. Combined with this is the learner's active role, achieved by using the computer as a tool to permit the student to be in control of the computer-user interaction.

Vitrine means showcase, and the project embodies two meanings of the word. The first, and more common use, is that of a setting or framework for exhibiting something, especially at its best. The second meaning which this project illustrates is that of a medium or vehicle for exhibiting a tentative offering or tryout of something. The *Vitrine* encompasses these two facets by using established technology while experimenting with new developments in both hardware and software. 2001 refers primarily to the street address (2001 St. Laurent Blvd.), but the futurist connotations evoked by this number were not unwelcome.

The Vitrine 2001 is also, by definition, an environment in a continual state of evolution. All of the aspects of the Vitrine evolve: the physical organization, the hardware, the software, the furniture, the teaching materials, etc. The individuals who work there evolve in terms of their actions, their observations, their research, and their learning.

As well as a functioning computer-based learning environment, the Vitrine is also a site which offers important possibilities for research. The project goal is to undertake learning-oriented research, in a context where the children's choices and their approaches are respected as much as possible. (For a more detailed description, see Winer et al, 1987.)

A static description cannot reflect the dynamics of the Vitrine full of children. When empty, it is simply a large space, roughly 30' by 36' at its largest, with fifteen to twenty computers,[1] arranged according to their uses, the tables available, etc. On the walls are examples of children's work, decorative posters (e.g., Leonardo da Vinci), aids for operating different software packages (e.g., the LogoWriter keyboard with commands and the image bank from MugShot), etc. On the tables and in the columns are instruction manuals, reference books (e.g., dictionaries), children's books, magazines (e.g., *Le petit debrouillard),* and decorative objects (e.g., a collection of turtles). There is also an "annex" in the basement which houses three additional ICONs on the same network.

From October 1987 to June 1988, we worked with three groups of students. 1) A grade two class from a multi-ethnic and multilingual inner-city neighbor-hood. The school had no computers, the teacher had no previous experience with educational computing, and none of the students had access to a com-

[1] We would like to thank Apple, Amisco, AT&T, Cameleon, Canadian Global Systems BLD Inc., CLASS Inc., Hexamedia-Televox, IBM, LCSI (Logo), Le Transit, Olivetti, Quebit, and Unisys for the loan of the materials used in the Vitrine 2001 project and for their continuing support.

puter. 2) A combined fourth/fifth grade class from an upper middle-class, francophone neighborhood. The teacher had been using computers for several years, there was a computer in the class, and the majority of the students had computers at home. 3) A group often adolescents in a provincial health care centre, all of whom had serious learning and psychological problems. The centre had a number of computers, but they were not being used as the previous experiences were judged less than satisfactory. The psychologist/ educator had no experience with educational computing.

THE MOST COMMON QUESTIONS

1) According to our visitors, the most striking feature of the Vitrine is that among our fifteen to twenty different machines, we have eight different types."W7iy *do you have a multi-machine, multi-software environment?"* In reflecting on this question, we found three answers. In the beginning, the reason was quite simply opportunism. We began with borrowed machines, or ones unearthed in our basements, those of friends, etc. Later on, when we were able to obtain equipment loans from different companies, we did not want to refuse anyone. However, we have now realized the advantages of this kind of environment, and we would not want to function any other way. If we were forced to make a choice and use only one type of machine, we would be the losers.

The first reason is human diversity, found equally in children as in adults. From a cybernetic perspective, it is obvious that in order to be able to respond to the variety inherent in such a complex system of learners, an enormous variety capability must be present in the environment (cf. Ashby's Law of Requisite Variety, 1958). To be able to respond to all of the children individually, when they are of different ages, interests, cultures, and abilities, we must have the richest possible environment. Richness is not used as a quantitative measure (there is not even one machine per child), but rather in the intangible sense of qualitative richness. The validity of this argument can be seen in the fact that each of the machines has found its place; each one, without exception, is used.

Related to this first reason is the fact that each machine and each program has its own "culture." Physically, the way one interacts with the machine is different: a trackball, a mouse, a keyboard. The visuals are either in colour or monochrome. The information output is either through the screen, music, or movement (e.g., Lego). Even software packages which have the same purpose (e.g., graphic animation) encourage different approaches. For example, I-Paint on the ICON is oriented towards linear objects and the concept of horizontal planes whereas the program FantaVision on the Apple IIGS uses the concept of objects and exploits the interaction of sound and movement.

The third contribution which this environment offers is on a conceptual level. Because it is a comparative and non-competitive environment, it encourages the development of a hierarchy of concepts and draws out the concept of "computer" rather than a specific machine. The child sees, by experience, which facts are applicable to a number of applications or machines, and which are those which have only limited generalizability. *"Thisprogram works in this way; all ofthe programs on this machine have this feature; all computers have this in common."* The child is placed in a context where she or he must make mental models powerful enough to accommodate the variety found in the environment.

Our findings to date are encouraging. The children explore the machines and the software and make comparisons between ways of doing. They discover the advantages and disadvantages of the differences. For example, a girl in fifth grade worked with I-Paint and did three films. At one point, she wanted to have two objects moving at the same time; she therefore switched to FantaVision which permits that. The counterpoint is a boy in the same class who, introduced to FantaVision by a classmate, returned to I-Paint because he preferred the trackball to the mouse.

Despite what many adults might have thought, the children have not become high tech snobs. They tell us that they want to write, to draw, to work with the Legos, etc.; they do not discriminate against a Max in favour of a Mac.

2) A second question concerns the influence that the children have on the environment. *"How do the children influence the changes which we make to the Vitrine?"* The Vitrine is in a continual state of formative evaluation and the children have influenced many different aspects. On the physical level, much of what is on the walls comes directly from the children (for example, the drawings or phrases). Indirectly, they have given us hints as to resources which would allow them to function more autonomously (e.g., translation of commands from English to French, instructions for starting the floor turtle), or which would make the use of a particular software package more efficient (for example, the posters of keyboards with the Logo Writer commands, the image banks for MugShot). They have given us suggestions for the location of the machines (e.g., separate the networked ICONs), and even for furniture (after observing that the children often squeezed two onto one chair, we commissioned a bench for two). The children have also had an impact on the software, either by specific suggestions (e.g., "we have x software package at school or at home and it's fun"), or by more or less explicitly expressed needs (e.g., "I want to create crossword puzzles"), or when we see a child who would be capable of going to a more difficult level, we try to find software which will permit more challenging interactions.

By the interests expressed and the difficulties encountered, the children have provoked modifications to the software itself (e.g., the development of *Canevas,* a program for making branching adventure stories on the Acorn; the translation of HyperCard into French and the creation of customized buttons; drawing and background banks which can be used to create animations with I-Paint), and even the creation of software (a LogoWriter program to control Legos with the Cam£l£on interface card).

The examples cited illustrate the ways in which the children have influenced the structural aspects of the Vitrine. There is, however, another aspect, perhaps less visible but certainly as real: the operational. The environment changes each week, and often numerous times during the day with the different choices that the children make. What they do obviously affects our actions, our intervention strategies, and our preparations for future visits. For example, once several children are familiar with a program, we will not respond directly to questions, but rather encourage them to consult a peer. The tactic of answering a question with another question is also used liberally.

3) A third question concerns management. *"How can one manage different projects of many children at the same time?"* The advantage of such an environment is that it can accommodate teachers with different teaching styles (individualized, workshops, traditional, etc.), who hope to achieve different pedagogical objectives (socio-affective, perseverance, cooperation, technology mastery, language arts, etc.). The environment permits a flexible management structure, adapted to the regular functioning of the children and their teacher.

We currently use four principal means to facilitate the organization of the activities at the Vitrine.

a) At the beginning of the year, each child received a binder in which he or she could keep notes, drawings, copies of productions, diskettes, etc. It is a personal and private space which permits each child to organize him or herself.

b) Badges are used by two of the research groups. In the case of the second graders, we observed that the environment was difficult to represent on a two-dimensional board because the choices made by the children changed the environment itself. As a result, we changed our way of presenting the choices to the children. We offered the complete range of possible activities in the form of badges; the environment is then created by their choices. During the course of the activities, the badges serve a management function for computer access — the children are free to explore, but the badge identifies their "home base," where they have priority.

The combined fourth/fifth grade class was project-oriented; they used the badges in order to establish group identification. Project-related work has priority over non-project work for machine access. A project is not necessarily related to one machine or one software program in particular; the badges, in their case, indicated who was working on what project. An Explorer badge, valid for one week, was also available; it conferred project status on a child who wishes to try out unknown activities.

c) All of the children filled out co-researcher forms. The forms were modified to suit the level and capabilities of the different groups, and also evolved over time to reflect the evolution of the Vitrine and the children. The forms have two purposes: 1) they are an important data-gathering tool; and 2) they are *a* tool for encouraging learning. In modifying the questions so that they correspond to the current level of the children, we tried to calibrate the questions to elicit reflections and provoke thinking.

d) The fourth means is what we call *"les pauses".* These breaks are moments for relaxation when the children "center" themselves (controlled breathing) before doing something else for ten minutes. The pauses impose a distancing and, consequently, allow the child to gain perspective on his or her actions.

4) *"What kind of learning does such an environment encourage?" As* the school year has just finished, we are far from being able to announce final or definitive results, but we are able to draw two preliminary conclusions. The Vitrine is an environment which not only favours process learning and problem-solving, but it offers continual and real encouragement and reinforcement. The only time that failure is mentioned is when a child gives up. For example, three children, working in a group, lost all of their work because they initialized *a* diskette by mistake. As a result, they learned about and integrated the idea of back-ups, and they have been initiating their peers. Even though they had to start over from the beginning, no-one spoke of failure or of time wasted. In contrast, two other children from the same class started a project which involved programming a game in Logo Writer; after one week they wanted to quit because they felt it was too hard. At that point, it was treated as a failure because they were not seeing the learning process that they had embarked on; they continued their project.

We have also realized the power of modeling for learning in this kind of environment. The children see, live with, and suffer through the fact that the adults do not always have the answers, that there is not always an answer, or that sometimes more than one answer is possible. Confronted with these "alleged experts," there are a number of possible reactions. They could lose respect for the adults; they could say that it wasn't even worth trying because even the adults weren't able to succeed; or they could do what happened in the Vitrine, take on the responsibility themselves. They have learned that no one can know everything. The important thing is to know how to look for information, to have useful strategies for exploring or debugging, either by consulting reference books, hints, peers, other animators, etc.

THE FUTURE — THE CHALLENGES WHICH AWAIT

We have just completed our first full year with children in the Vitrine and are analysing the data collected; results will be published as they become available. We can see that many of our efforts have started to bear fruit recently; for example, a higher level of success and perseverance than the teachers had thought possible at the beginning of the year has been attained. We are satisfied, but at the same time are very conscious of the challenges which await us in the coming years. We believe in the vision of educational computing which the Vitrine lives. But it is clear that with innovation, new challenges also appear. The current challenges concern three different themes.

1) Watching the children in action, it is relatively easy to observe their learning and their progress. The challenge here is addressed to evaluators in the school system. Because we would like to see environments like the Vitrine integrated into the regular school system, we must find ways to follow the children and recognize their efforts and their achievements.

2) The second challenge is addressed to researchers. The richness and the variety of activities is difficult to grasp and analyse with traditional research methods and tools. We have already started working on the problem and are currently experimenting with the use of existing computer applications in innovative ways to respond to the particular needs of these new situations.

3) The third challenge is addressed to all those involved in educational computing. The new computer-based learning environments are creating new roles for all of the participants: the children have taken on the role of co-researcher; the teachers are leaving the role of transmitter of knowledge and are learning-facilitators in the same environments as their students; the animators still show others, but they also act by letting themselves be acted upon. These new roles are blurred; it is incumbent upon us to better distinguish and define them.

REFERENCES

Ashby, W. R. (1958). *Introduction to cybernetics.* New York: John Wiley & Sons.

Brown, J. S. (1985). Process versus product: A perspective on tools for communal and informal electronic learning. In M. Chen & W. Paisley (eds.) *Children and Micro computers — Research on the newest medium.* Beverly Hills, CA: Sage Pubs.

Papert, S. (1980). *Mindstorms.* New York: Basic Books.

Winer, L. R., Tremblay, P. S., Bonnier, F., Lafeuille, J., and Bordeleau, P. (1987). *La Vitrine Electronique 2001: Un environnement pedagogique pour apprendre avec I'ordinateur.* Montreal: APO Quebec.

AUTHOR

Laura R. Winer is Project Coordinator of the Vitrine 2001 at APO Quebec, 2001 St. Laurent Blvd., Montreal, PQ H2X 2T3. The Vitrine 2001 team consists of Laura R. Winer, Pierre-S. Tremblay, Michel Perusse, and Marion Barfurth.

Developing Instructional Materials for Distance Education: A "Concerns-Based" Approach

Som Naidu

Abstract: Common approaches to instructional materials development currently used at distance education institutions are reviewed in this paper with the team approach considered in some detail. It is argued, that to a very large extent, the success or failure of most team approaches can be traced to the management of the team's effort. Good management of the process is not only being concerned with getting the administrative procedures right but also with effectively managing the concerns and aspirations of all individual participants In that effort. It means being sensitive to entry-level behaviours of individual members as well as being able to guide their development towards successful achievement of the team's objective. A model for adopting educational innovations using the individual and the innovation as the frame of reference —the Concerns-Based Adoption Model— developed by Gene Hall and others is proposed to show how it could be applied to cope with this issue.

INTRODUCTION

The most distinctive characteristic of distance education (hereafter referred to as DE) is the separation of the teaching and the learning activities. Since much of the teaching activity is incorporated in the instructional materials prepared well in advance of the learning activity, the proper development of these materials becomes very important to the ensuing learning activity. Distance educators are aware of the importance of effective instructional materials and have, over the years adopted a variety of approaches to develop the best possible materials for their requirements. The most common approaches are briefly reviewed in this paper with the team approach considered in greater detail.

Discussion is focussed on the management of the instructional materials development (hereafter referred to as IMD) process especially within a collaborative team environment. It is argued in this paper, that for the majority of course team participants instructional materials development for DE usually comprises a new experience —an innovation— which if inexpertly managed is the source of much trouble within the team. An innovation adoption model from the educational literature which uses the individual and

CJEC, VOL. 17, NO. 3, PAGES 167 -179, ISSN 0710-4340

the innovation as its frame of reference is proposed to show how it could serve to expertly guide the management of this process in DE.

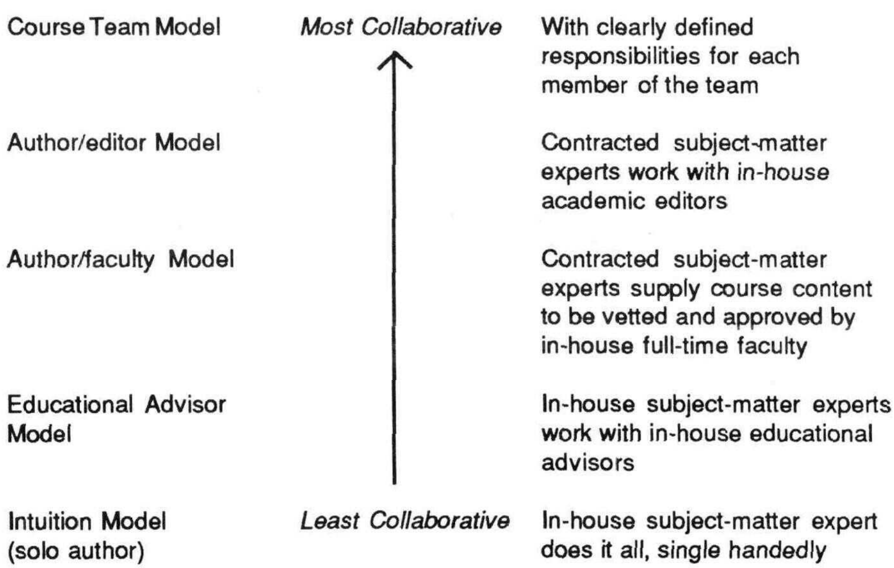
Common Approaches

In a review of the commonly adopted approaches to instructional materials development in DE, Smith (1980) identified at least *five* clearly distinguishable models currently used by DE institutions around the world. These are:

1) the course team model;
2) the author/editor model;
3) the author/faculty model;
4) the educational advisor model; and
5) the intuition (solo author) model.

The basic differences between them is best understood when seen on a continuum of approaches with the course team model on one end, and the intuition (solo author) model on the other, as in Figure 1 below.

Figure 1. *Commonly Adopted Approaches to Course Development in DE.*



The course team model on one end of this continuum exhibits the most collaborative effort with the largest number of people involved in the activity. These usually include subject-matter experts (SMEs), educational technologists/instructional designers, editors, and media specialists, each responsible for their particular areas of expertise. Not always the most successful approach, the course team model has been widely used by institutions around the world, especially the Open University of the United. Kingdom (UKOU), its original proponent. On the other end of the continuum we have the intuition (solo author) model, which involves the least collaborative approach by way of the number of specialist staff engaged in the IMD process. Without suggesting that this approach is any better or worse than any of the others, it is characteristic of institutions which rely on a single SME to develop all the materials necessary for distance study.

We have between these two extreme approaches, a variety of others not very different from one another. Three of these bearing distinctive differences appear on this continuum. Their positions on the continuum reflect the degree of specialist instructional design input in the process.

Choosing a Model

An institution's decision to choose a particular model is usually based on, inter alia, its academic tradition and resources available to it for DE activity. Notice that institutions exclusively concerned with DE such as the UKOU, Athabasca University, the Open Learning Institute in Canada and the Sukothaithamathirat Open University of Thailand, have tended to adopt a more collaborative team approach, while the more traditional campus-based institutions, having decided to engage in DE along with their other functions have tended to adopt lesser collaborative approaches, more out of necessity than choice. Examples of the latter are the University of the South Pacific, Massey University in New Zealand, University of Queensland and a host of other Australian institutions. Generally speaking, however, as institutions become more and more deeply engaged in DE activity, and hence more familiar with its character and complexity, the tendency has been for them to adopt more and more collaborative approaches in their IMD process, as has been the case at the institutions listed above. This is not the same as saying that the more collaborative the approach the better is the process or even the end product.

Teams can be democratic, autocratic or even technocratic and team characteristics are also susceptible to vacillation. Sometimes the most democratic teams have ended up as the most autocratic and the vice versa is also true. In fact collaborative team approaches to instructional materials development in DE have really been quite notorious for their inability to co-exist without serious difficulties. The intricacies of team approaches and their problems are very ably documented by Batten, 1980; Crick, 1980; Delecroix, 1978; Lewis, 1971; Livingston, 1979; Mason, 1976; Newey, 1975; and Stringer, 1980.

Management of the IMD Process

To a large extent, in my view, the success or failure of most collaborative team approaches to instructional materials development in DE can be traced more than anything, to the *management* of the team's effort.

An instructional materials development team in DE is by nature a group comprised of people from different professional backgrounds, sometimes as many as four or more. While its overall objective for getting together is usually clear — the development of instructional materials for DE — there are several hidden agendas and individual team member aspirations that are not as clear. When these are coupled with ineffective leadership of the team, there are a lot of problems which lead to not only a lack of credibility all around, but poor instructional materials and, not too infrequently, abandoned projects.

Most collaborative team efforts at developing instructional materials for DE, include at least one subject-matter expert and an editor or course developer. At best the latter may be an expert instructional designer. Very often the SME is a campus-based classroom teacher with little or no experience or expertise in the development of instructional materials for DE. The editor/course developer may have greater empathy with the distance learner and a little more experience in instructional materials development for DE. Whatever materials production expertise per se the two may require is requested as and when necessary. While this comprises a fairly accurate picture of the IMD scenario at the majority of DE institutions operating today, increasing numbers of DE institutions are able to afford a lot more elaborate teams than that, which include several more SMEs, educational technologists and media specialists.

For the majority of the members in the team, participation in the IMD process comprises a new experience (Eastcott, 1981). An experience which not only calls for new skills but some "de-skilling" as well, that is, shedding of certain old habits (Nisbet, 1974). Old habits die hard and when members of the team are faced with circumstances that render some of their previous experience "irrelevant" there is quite a lot of uneasiness, loss of confidence, disillusionment, hostility, and at times withdrawal from the activity altogether. In Nisbet's terms very often the "bandwagon becomes a hearse."

A lot of this disillusionment in the course team, however, can be avoided through effective leadership and good management of the instructional materials development process. Good management of the process is not only a matter of being concerned with getting the administrative procedures right but also with effectively managing or co-managing the concerns and aspirations of all individual participants in that effort. Good management means being sensitive to entry-level behaviours of individual members and their development during the process. Good management means knowing how to expertly cope with the changing concerns and aspirations of members, and how to move them towards the successful achievement of the team's objective which, in this case, is the development of instructional materials for DE.

This has been the major orientation and firm conviction of a team of researchers at the University of Texas Research and Development Centre for Teacher Education. Led by Gene E. Hall, this team has, for more than a decade now, worked on the development of a set of systematic procedures for adopting educational innovations using the individual and the innovation as their frame of reference (Hall, 1979). The product of their work is the *Concerns-Based Adoption Model* for the adoption of innovations. Although much of this group's work, so far, has been concerned with teacher education, since it was commissioned by the U.S. National Institute of Education, the procedures they have developed are generally applicable to the adoption of change and innovation.

The Concerns-Based Adoption Model

The concerns-based adoption model (hereafter referred to as CBAM) comprises a set of procedures for the effective adoption of change and innovation in human societies. These procedures are distinctly grounded in the concerns of individuals who are or hope to be adopting an innovation, including anything from a new product on the market, such as a food or drink item, to a new banking/shopping service facility.

The basic assumptions of the model are :

1) that change is a process rather than a single event and that it takes time to unfold;

2) that change is essentially made by individuals and that without a change in individuals, it is not likely that an organization will be able to initiate, maintain or institutionalise change;

3) that for these individuals change is a personal experience. To understand and facilitate change, attention must be given to this personal dimension of the process; and

4) that change entails developmental growth in terms of an individual's feelings about the innovation and skill in using the innovation (i.e., an individual is not one day completely naive in relation to the use of an innovation and the next day an instantaneous expert and a highly skilled user).

CBAM is specifically directed at the process of change and the adoption of innovation. It is not concerned with *decision-making* or the bringing about of decisions. It therefore assumes:

5) that the change or innovation in question is appropriate and desired; and

6) that there are formal or informal leaders who will be the *change facilitators.* These persons may be from within the organization or from outside it. They may be senior administrators or persons from the human resources development office or consultants from outside, but their generic function would be the same — namely, to assist users and non-users of an innovation to improve their levels of use and develop their concerns towards a more desirable stage.

The key dimensions then, of CBAM are the *Stages of Concern* of individuals, and their *Levels of Use* of the innovation.

Stages of Concern

The concept of concerns relates to the feelings, perceptions, motivations, and attitudinal dynamics of individuals as they first become aware of an innovation, approach it and gradually become increasingly confident in their use of the innovation. These concerns when determined are categorised in one or more of the following stages in the CBAM.

Figure 2. *Stages of Concern About the Innovation.*

AWARENESS: Little concern about or involvement with the innovation is indicated.

INFORMATIONAL: A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be worried about him/herself in relation to the innovation. He/she is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.

PERSONAL: Individual is uncertain about the demands of the innovation, her inadequacy to meet those demands, and her role with the innovation. This includes analysis of her role in relation to the reward structure of the organizatbn, decision-making and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.

MANAGEMENT: Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organising, managing, scheduling and time demands are of utmost importance.

CONSEQUENCE: Attention focuses on impact of the innovation on clients/ subjects in the individual's immediate sphere of influence. Focus is on relevance of the innovation for its recipients.

COLLABORATION: Focus is on co-ordination and co-operation with others regarding use of the innovation.

REFOCUSSING: Focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.

Note: Adapted from Hall, G. E. (1979). *Australian Educational Researcher, 7(2),* 5-32.

The stages of concern of users and non-users can be determined by expert interviewing, together with questionnaires specifically designed for this purpose. Persons carrying out the interview are required to undergo special training in its techniques. A manual for trainers, interviewers and raters has been developed for this purpose. Training workshops in the use of these tools are also available at the Development Centre for Teacher Education.

Development of Stages of Concern

Research on individuals' stages of concerns has discovered that individuals do not have only one intense stage of concern at a time, rather a concerns "profile" with some stages of concern relatively more intense than others and, which change quite predictably as individuals become more and more familiar with the innovation. Hall and his colleagues found that, generally, "non-users" of an innovation tend to express their most intense concerns at stages 0,1 and 2 (self-concerns) and with their least intense concerns at stages 4, 5 and 6 (impact concerns). As use of the innovation is adopted, their management concerns (task concern) become more intense while their self-concerns decrease in intensity. As user experience with the innovation increases, the researchers found that management concerns of individuals gradually decrease in intensity and various impact concerns (stages 4, 5 and 6) increase in intensity.

Levels of Use of Innovation

Levels of use of an innovation focusses upon the patterns of behaviour of the individual as he/she approaches and uses an innovation. CBAM has identified eight levels of use which are operationally defined in Figure 3 on the next page. Levels of use of an innovation by individuals can be determined by focussed interview or ethnographic procedures. Users of these tools will require training in their use as well.

Innovation Configurations

A third dimension of CBAM is the innovation's configurations. The notion of this is that as innovations get adopted, they are very likely to be adapted or *mutated* While change agents and users of innovations may not always be able to agree on acceptable configurations of an innovation, some attempt is made in the model to ensure retention of an acceptable identity of the innovation. CBAM utilises a configuration checklist drafting procedure called "configuration hunt" along with interviewing and on-site observations to maintain this identity. Subjects/clients may also be asked to compile innovation configuration checklists.

The CBAM Schema

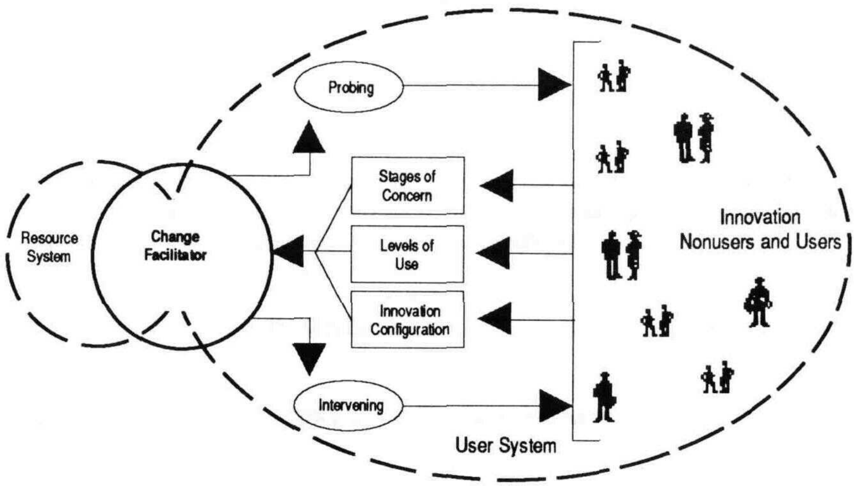
An overview of the process involved in the model is illustrated in Figure 4 on page 175. The users and non-users of the innovation, as shown in this schema are part of the *user system.* The change facilitator (leadership/management) may be part of the user system or a consultant from the *resource system,* that is the organization or the institution concerned with the change. Regardless of origins and location, the change facilitator's role is to work with the users and non-users of the innovation individually and/or in groups to enhance their

Figure 3. *Levels of Use of the Innovation.*

0	NON-USE	State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.
I	ORIENTATION	State in which the user has recently acquired or is acquiring information about the innovation and/or has recently explored or is exploring its value and its demands upon user and user system.
II	PREPARATION	State in which the user is preparing for first use of the innovation.
III	MECHANICAL USE	State in which the user focuses most effort on the short-term day-to-day use of the innovation with little time for reflection. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.
IVa	ROUTINE	Use of the innovation is stabilised. Few, if any, changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
IVb	REFINEMENT	State in which the user varies the use of the innovation to increase its impact on clients within the immediate sphere of his/her influence. Variations are based on knowledge of both short and long-term consequences for clients.
V	INTEGRATION	State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
VI	RENEWAL	State in which the user re-evaluates the quality of use of the innovatbn, seeks major modifications of or alternatives to present innovation to achieve increased impact on clients, examines new devebpments in the field, and expbres new goals for self and the user system.

Note: Adapted from Hall, G. E. (1979). *Australian Educational Researcher, 7(2),* 5-32.

Figure 4. *The Concerns-Based Adoption Model.*



Note: Adapted from Hall, G.E. (1979). ***Austral/an Educational Researcher, 7(2),*** **5-32.**

confidence and competence in the adoption of the innovation. He/she is also responsible for ensuring that acceptable configurations of the innovation are being adopted at all times. The role of the change facilitator in this schema, therefore, is an extremely critical one requiring a high degree of skill in problem-solving and management of interpersonal relationships. He/she is the manager of the innovation adoption process responsible for diagnosing user concerns and levels of use of the innovation, and based upon that, for introducing appropriate interventions in user behaviour. This comprises a very large responsibility successfully achievable only over extended periods of time, usually several years.

Application of CBAM

An example of how the mechanics of CBAM could be suitably applied in the development of instructional materials for DE is attempted in Table 1 (see next two pages). The strategies suggested therein are by no means the only ones. They offer an example of how a change agent possibly in the form of the course team leader, instructional designer or course developer could manage the IMD process. Notice that the subject of instructional materials development and instructional design in particular are brought up only at the *impact level* of concerns. The reason for this is that instructional materials development for DE comprises a very specialised task that can not be effectively carried out without a good grasp of the nature and function of DE in general. Its discussion will be meaningful only after participants' concerns about the nature of DE as a whole have been sufficiently dealt with. Eventual success of this program of action will be possible through good management and effective leadership but

TABLE 1
The Application of CBAM to the Development of Instructional Materials in DE (Table spans two pages)

STAGES OF CONCERN	AWARENESS	INFORMATIONAL	PERSONAL
Typical expression of concern of individuals.	I don't know anything about DE and am not interested.	I dont know very much about DE but would like to know more.	I am not very sure I will be able to do this. How will it affect me?
LEVEL OF USE OF INNOVATION	NON-USE	ORIENTATION	PREPARATION
Major Focus of Innovation	Raising awareness	Providing information	Establishing relationships
Intervention Rationale	A lack of concern and/or awareness is very legitimate and ought to be expected.	Keep information relevant, basic and simple. Present it progressively rather than all at once.	Personal aspirations and fears at this stage are realistic. Acknowledge aspirations and allay fears.
Intervention Strategy	Sensitize individual to the need for change and the challenges of DE. Its relevance to the institution and the client.	Provide overall picture of DE activity, costs and benefits, instructional materials development and student support activity etc.	Develop confidence in the individual while enhancing faith in the tasks involved.
Suggested Interventions	Vigorously publicize the challenges and relevance of DE. Follow up with resource material for individuals. Obtain feedback. Incite disussion and debate. Hold short orientation workshops for small groups (no more than 5 at a time). Invite the converted to present their success stories.	Hold short workshops to explain the nature of DE activity and its function in the context. Follow up with resource materials for individuals. Obtain feedback. Arrange on-site visits of study centres, materials production sites, dispatch/delivery etc.	Offer plenty of encouragement and promise of support. Use several case studies of innovative success stories by their own colleagues, if possible, to show that it can be done. Establish realistic expectations, easily achievable but challenging tasks at first.

TABLE 1, cont'd
The Application of CBAM to the Development of Instructional Materials in DE

MANAGEMENT	CONSEQUENCE	COLLABORATION	REFOCUSSING
It's getting organized that is taking a lot of my time	How can I improve my work for better student/client performance?	How can I work with others to increase my impact?	I think I have a better way here!
MECHANICALS ROUTINE USE	REFINEMENT	INTEGRATION	RENEWAL
Demonstrating procedures	Experimenting with new designs	Establishing networks	Facilitating renewal
Very realistic concerns. These must be promptly resolved to sustain participant interest.	An acceptable level of use (LoU) has been reached. There is readiness for new information.	There is interest in sharing information and skills. Facilitate it through networks.	Be receptive to new ideas but careful with divergent thinkers and major shifts in innovation configurations.
Demonstrate how to get organized. Leave no concerns unresolved. Use focus groups to diagnose problems and arrive at possible solutions.	Introduce and experiment with sound models of ID, evaluation and reconstruction of efforts.	Facilitation of networks and net-weaving of ideas and skills. Keep tabs and follow these through.	Offer support for renewal of ideas but only after establishing clear parameters.
Examine each specific concern. Offer specific "how to" strategies. Follow up with support. Arrange workshops of people with similar concerns. Hold small problem-solving focus groups on time and resource management, and workloads. Offer models/role models if available.	Provide on-going support. Make available new literature to individuals on instructional design. Obtain feedback. Share in workshops with interested participants. Involve individuals in assessment, evaluation exercises. Use their expertise.	Encourage development of networks — groups or on-line. Ensure information flow. Use collaborative team effort to publish, produce and evaluate. Document these. Encourage individuals to initiate these efforts and be responsible for them.	Initiate and support pilot projects and new directions, using participant leadership. Introduce new design models. Draw from other fields, consolidate. Allow participants to initiate, lead and conduct. Be willing to help but careful not to lose control.

not without a good amount of *readiness* on the part of the individuals participating in the process as well.

CONCLUSION

Instructional materials development for distance education is a complex process and expert management of it is essential towards achievement of a successful end product. Yet, while this is so, distance education literature has not, as yet, suitably addressed the process of IMD. Meticulous adherence to the principles of instructional design and development have been found to be insufficient on their own. They do not address, for example, the question of how one might best be able to harness the wide range of skills and resources that is often drawn into a course team.

While CBAM does not originate in distance education literature, it was developed within the context of innovation adoption in higher education and in this author's view offers the best framework to-date for a systemic approach to the management of any form of collaborative approach to IMD for distance education. In this manner CBAM is very much a generic model for innovation adoption and can be applied in distance education as is. A sure strength of the model is its usefulness as a means for zooming in on very specific concerns of individual users and participants. Where groups of individuals share similar concerns, these can be addressed just as effectively.

REFERENCES

Batten, P. (1980). Some notes on one person course teams. *Teaching at a Distance, 18,* 10-12.

Crick, M. (1980). Course teams: Myth and actuality. *Distance Education, 1,* 127-141.

Delecroix, M. (1978). Questions for the course team. *Open Line, 20,* 7-9.

Eastcott, L. R. (1981). *External studies as an innovation for the academic.* Paper presented at the ASPESA Forum, Fiji Islands.

Hall, G. E. (1979). Using the individual and the innovation as the frame of reference for research on change. *Australian Educational Researcher, 7(2),* 5-32.

Lewis, B. N. (1971). Course production at the Open University: Some basic problems. *British Journal of Educational Technology,* 2(1), 4-12.

Livingston, K. T. (1979). Course design and development: Some practical implications of the team approach. *ASPESA Newletter,* 5(1), 27-44.

Mason, J. (1976). Life inside the course team. *Teaching at a Distance, 5,* 27-33.

Newey, C. (1975). On being a course team chairman. *Teaching at a Distance, 4,* 47-51.

Nisbet, J. (1974). Innovation: Bandwagon or hearse? *Bulletin of Victorian Institute of Educational Research, 33,* 1-4.
Smith, K. C. (1980). Course development procedures. *Distance Education, 1,* 61-67.
Stringer, M. (1980). Lifting the course team curse. *Teaching at a Distance, 18,* 13-16.

AUTHOR

Som Naidu is a course developer for distance education at the University of the South Pacific based in the Fiji Islands. He is currently on leave working on a Ph.D. in Educational Technology at Concordia University, 1455 de Maisonneuve Blvd. W., Montreal, PQ H3G 1M8.

Forging the Links: Computers and Dispersed Faculties

Miriam K. Mills

Abstract: This paper will deal with the potential impact of interactive technologies as an option for faculty development between dispersed areas. Among the topics considered are the ways in which the talents of the dispersed areas' faculty can be meshed to the end of producing more informed and engaged educators. Many institutions of higher learning concerned with maintaining the current skills and developing new talents of faculty will sometimes find themselves thwarted because of financial constraints which limit their ability to have faculty members travel to meet with their counterparts elsewhere. Technology provides a framework within which continued interaction can occur while still maintaining the continued presence of faculty within the classroom. More critical than the simple interchange between individuals is the building up of a network of peers transcending national boundaries. Developing countries can economically sustain and enrich the competence of their existing faculties. In addition, present obstacles to faculty recruitment and retention can be offset by facilitating professional interaction with distant colleagues.

INTRODUCTION

At the same time as society presses for productivity through the intelligent use of technology, there is a concomitant need for expanding human capacity. The ability to grasp, use and transmit information calls for the development of new skills. If further human progress is to keep pace with what production and information technology have wrought, greater efforts in intellectual technology are called for in order to "amplify man's learning, analytical and problem solving power" (Molnar, 1982, p. 7).

The development of human amplifiers may be an American construct, but it is reasonable to suppose that similar views would exist in many other countries. The communication forms which are conducive to human interaction and which are computer-mediated are genuinely active in the sense that they develop powerful new systems of interaction. Working groups create resonances and synergy through exposure to network interactions. What becomes transmitted is more "know how" than archival materials. Computers make it possible to efficiently organize and analyze data. The importance of this to higher education cannot be overstated.

CJEC, VOL. 17, NO. 3, PAGES 181 -196 ISSN 0710-4340

The key contribution of universities to society is to improve intellectual productivity. The traditional university functions must begin to respond ever more imaginatively to the "intellectual realities of the computer revolution" (Van Horn, 1986, p. 55).

> We are, whether fully conscious of it or not, already in an environment for higher education that represents the most drastic change since the founding of the University of Paris and Bologna . . . some eight or nine centuries ago. (Muller, 1983, p. 47)

> One can predict students will have access to what Philip Macedon's son, Alexander, enjoyed as a royal prerogative, the personal services of a tutor as well informed and responsive as Aristotle. (Suppes, 1966)

Many of those now in education were trained in the pre-computer era. Through seniority such individuals may readily assume leadership positions and have problems with the newer, younger, more technologically advanced colleagues. Not only is there the pressure from colleagues, there is in developed countries, an equal force for change emanating from students. In privileged communities, computers are well integrated into primary education. Those of the pre-computer era have, as a result of lack of exposure, less ability to bring the wonder of learning forward. Such faculty members can either withdraw from the spectre of a new technology, or hasten to catch up as best they can.

The author had been engaged in a project to overcome faculty resistance to change. The method was computer conferencing which had the virtue of being simple to learn and invisible to the outside world. The uneasy faculty member could efficiently deal with facts and feelings related to comprehending the boundaries of technology. Best of all, such views could be shared anonymously. One could ask very basic questions without fear of looking foolish or having too primitive an understanding.

In post-course evaluations, of the 15 professors representing 11 institutions, 13 expressed satisfaction that overcoming "fear of keyboard" had been accomplished. This program had been based at an east-coast university, with other east-coast institutions, concurrent to the discussion forum which the author moderated, there were a number of substance courses offered through computer conferencing, including such topics as integration of computers in music, mathematics and foreign languages. The project participants took such courses in conjunction with the discussion group on-line conference.

The issues of great consequence for higher education revolve on issues of information dissemination, shared access, and remote interaction. If we regard the mission of educational institutions as the creation, storage, and dissemination of information, communication networks are tools to be used in accomplishing these tasks more effectively as they facilitate fast, reliable information and resource sharing (Barden & Golden, 1986).

Yet there are differences in objectives between administrators and faculty. Speaking initially of developed countries, extensive use of computers enhances the image of the institution and thus the perception of competence of the leadership. There have been occasions when the commitment has been made, for example, to provide all incoming students with computers. Less attention has been given to how they will be utilized by entrenched faculty that may be disinterested or hostile to a new technology. Grudging acceptance of administrative goals does not lead to enthusiastic and creative teaching.

When the author was in Africa recently, she was exposed to programs using computers for union steward education. In Kenya, the Central Organization of Trade Unions (COTU) was eager to have their extension level courses become accredited. The skills that union leaders and trainers had were not necessarily consistent with what a university would accept. In discussions in 1986 with COTU officials, there was considerable enthusiasm for computer conferencing which would make it possible to have an academic participate in what had thus far been training programs. Once greater consideration was given to underlying academic principles which helped shape episodic experiences, COTU believed it would be possible to give students college credit for what they learned through extension programs. A significant factor was cost. The University of Nairobi could not stretch its resources to encompass education in the field. Since phone lines and terminals were readily accessible, COTU leadership reasoned, there should not be overwhelming resistance.

At a graduate program offered at the air force base of Panama, officers had a difficult time coming for the concentrated program which earned them three graduate credits. Military manoeuvres, off-base assignments, and frequent schedule changes made attendance difficult. Many more would have been eager to participate if they had felt that a one or two session absence would not be disastrous. The peril of scheduling could so easily be overcome by a combination of videotaping of lectures coupled with computer conferencing for discussion with faculty beyond regular class hours.

It is now possible to store information in any form (audio, visual, digital, or any combination of these), retrieve it whenever we want and send it instantaneously anywhere in the world. The fact that it is not being done on a more widespread basis speaks less to our ability than to fiscal, political, and cultural constraints (Winn, 1985). These constraints are as evident in universities as they are in countries. Fiscal constraints can sometimes be overcome with judicious trade-offs or exchanges. If the institution is committed to advancing technological competence, then the finances can follow.

Political constraints also exist in terms of departmental competition, administration-faculty conflict, and intradepartmental disagreement. The knowers versus the yet-to-know can sometimes jeopardize their future if change is introduced too abruptly and the learning gaps of more senior faculty are made self-evident.

It is the cultural constraint that may be at the core of the issue. Does the society recognize the possibility of balance between reverence for established values and commitment to modern technology? It has been said that in Iran, the power of the Ayatollah was vastly enhanced through transistors and cassette players. While deploring the "scourge" of western culture, the presence of the Ayatollah was spread broadly by access to western technology.

For those institutions concerned with installing dispersed learning programs, interactive technology makes possible multi-campus sections, special structure, electronic learning and continuing education at the work place. It may be instructive to comment on some of the advantages. In addition to reduced turn-around time, there is more certainty of text content, reduced cost of communication and above all, electronic transferability. Costs can also be traded off with other communication media and alternatives.

Clearly, the lack of effective communication systems is an impediment to industrial collaboration, research cooperation and resource sharing in many countries of the third world. The process of building a traditional communication infrastructure is slow and expensive. There is the need to enable scientists within a developing country to communicate with each other and their colleagues in other countries, both industrialized and developing (IDRC, 1981).

Yet this sense of urgency may not be common to all countries. While all may support in theory the ready exchange of knowledge, such participatory sharing may diminish the "lead" that one country has obtained. In implementing such programs, only shared values will make possible shared knowledge. Some countries may fear the potential of interactions that transcend the boundaries of specific topics. The very candor and forthrightness made possible by, for example, computer conferencing may well serve as an object lesson of a different form of learning and interaction. Yet the steady growth in computer use is attributed to sharply rising travel costs, increase in labour, and an 11% decline in communication costs (Ehrenberg, 1984).

Through computerized conferencing, the potential exists for participants worldwide to engage in many on-line conferences simultaneously as well as to maintain informal liaison with colleagues, similar to conversations over lunch. Not only can participants enter conferences from any location, but they can still attend to all on-site local responsibilities. Thus, the power of the individual to act, interact, and react is reinforced by this technology. Yet it is this very notion of power that can thwart its utilization.

There is also software support for significant educational roles. User consultants serve as a vital resource for both new and experienced users. Group coordinators help to focus task attention. The conference moderator provides access and direction to conference participants. By permitting outsiders to have access to one's individual notebook, either as a full participant or as observer, much necessary information can be transmitted.

Computerized conferencing has specific educational applications which are supportive of traditional course design or newer learning systems. Traditional courses are supported through such features as: electronic office hours, coordination of large courses, curriculum design, electronic grade books, thesis advisement, and specialized tutorials. These benefits, however, are only likely to be valued by more established institutions. It is a method that facilitates academic administration rather than learning. Paradoxically, however, it may be the administrative aspects that will be easier to promote in third world countries because it is relatively less controversial. The benefits are clearly visible. The time of faculty can be used in the classroom rather than in the office.

However, in ideal terms, the use of interactive technology for learning can serve a number of needs. The first is the exchange of messages whereby a dialogue is set up between contributors of selective, fragmentary, and occasional information about the conduct of their own particular activities and having no meaning outside the context of these activities. The second level would be one wherein the opportunity is presented for more detached discussion in which the study groups would be formed to exchange ideas, to work out analyses, arrive at assessments, and make decisions. This cumulative process permits the establishment of a collective memory to which the individuals can refer as frequently as needed. Because of the ease with which materials can be inserted and extracted, newcomers to an institution can readily join in the system and benefit from the accumulated wisdom already incorporated within the memory drawn from that particular group.

NEGATIVE ASPECTS OF INTERACTIVE TECHNOLOGY

Yet such interaction is not an unmixed blessing. Some of the possible reasons for the limits of technology in education include: resistance by teachers, high costs, and the absence of demonstrable gains in student achievement (Bok, 1985).

Does the technology actually contribute to the effectiveness of education? Many widely used technological innovations seem principally designed to save time or eliminate drudgery. The undue attention given to the convenience of dispersed learning may tend to give too low a weight to the other benefits of interaction at a viable campus.

> There is no room in this format for challenging students to define the problem for themselves, explore a new hypothesis of their own, or speculate about the material under study. Because of these limitations, computer assisted instruction is chiefly used to help learn facts, basic routines … computer programs simulate a patient and permit medical students to ask questions and order tests in an effort to diagnose the illness. With such programs, the role of the machine is entirely different. In making use of these devices however, educators must remember that they are reiving on a still unproven theory of how to teach problem solving. (Bok, 1985, p. 4)

There can be objections raised to video conferencing. In its early attempts, much of video conferencing depended on a TV-oriented style of presentation. The result was ". . . the 'Hollywood' syndrome, a formal visually complex-broadcast, that left a lot of executives feeling pressured and nervous about 'performance' " (Ehrenburg, 1984, p. 7).

Today more of the "performance" has been reduced. The end result is more likely to be a real life face to face situation. The quality of education received at a distance may be reduced rather than enhanced by technology. "It is only through the sound application of basic principles of communication and instruction, not through bigger and fancier gadgets, that we will be able to enhance distance education through technology" (Winn, 1985, p. 112). When applied to a university setting, however, there are interesting benefits. The faculty/performer sees the selection as being recognition of special competence. Despite the onerous task of developing an appropriate lecture and providing effective normal uses, the device itself represents the designation of competence.

Administratively, such video-teaching represents a boon to university structure. Outstanding educators can be in effect frozen in time. Their presence and competence remains enduring and transportable.

The integration of educator and practitioner is an especially provocative one for developing nations. Because of many vital needs within developing countries, methods must be found to fully utilize national talents. The history of emerging countries is still alive and throbbing. A link of academic and new government leadership provides the basis for a vivid compilation of national development.

Van Horn has argued that educators must identify where students spend most of their time as this will give a clearer picture of the learning environment. The places he identified are the library as a knowledge base and through interaction with other students. What should be observed is how students control the learning process with regard to the computer. Institutions tend not to heed the process and are instead trying to impose levels of faculty and administrator involvement in the use of computers. This approach overlooks an effective and necessary way to involve students with computers.

> Universities should not require courses about computers and programming as part of the curriculum. Rather, we ought to provide computing environments where students can learn all they need from each other. Faculty members can learn about general tool; they don't need six months off to prepare course-specific material. (Van Horn, 1986, p. 18)

PROS AND CONS OF COMPUTERS FOR PROFESSIONAL DEVELOPMENT

One of the most immediate potential applications of interactive technology is to dispersed educational development. The instructor and participants can remain stationary with information itself travelling. Although efforts in this area are only now beginning to emerge, there is potential for transforming some already existing educational efforts. The delivery of vocational education in Alaska through different media is instructive. Thirty such strategies were described by Johnson to overcome problems of delivering vocational programs in rural schools. The study was designed to provide easy adaption to local use. Strategies of cooperative schools, flexible scheduling, use of television and radio, learning systems, correspondence studies, mini-courses, learning on athletic trips, teacher exchanges, conference calls, computer-assisted instruction, independent study, and programmed activities were all used (Johnson, 1981).

Beginning in 1971, the International Education System Plan was undertaken in Nepal to modernize education. Emphasized most strongly was vocational education to meet the country's technical manpower needs. The attempt was undertaken to make education more relevant to the needs and aspirations of Nepal by linking education with productive enterprise and egalitarian principles. The result was reorganized school programs including work programs integral to the school curricula, character building, pre-vocational training integrated with school curriculum. The earning while learning program and the plan to involve vocational education students in local development projects could easily have been planned and coordinated through computerized conferencing. Given the sometimes limited numbers of skilled professionals available for instruction, the use of on-line conferences would permit the broader dissemination of knowledge at reduced cost.

To date, little formal adult education exists in Nepal, but government agencies, cottage industries, private agencies and national youth programs provide a small percent of the out-of-school population with crafts, religion, agriculture and literacy training. Centered in the schools and youth organizations are several projects including the education for rural transformation and the Badikhel drinking water project (Nepal National Education, 1978).

Another example of the use of tele-education was summarized by Hammond (1978) in considering the activities at the British Open University. Large numbers of students at the Open University of England are prevented from having any higher education by factors such as geographic remoteness, physical disability and financial or family obligations. Most are full-time employees and or raising a family.

The Open University communicates via mail, radio or television. Students may attend tutorial regional study centers once or twice monthly or attend summer school. Telephone teaching provided the first opportunity for involving students in tutorials, discussions and self-help programs. Equipment allowed up to eight students and tutor per discussion out of their homes.

The major reason for taking part in conference calls was that leaving home or meeting new people at the study center was difficult when evening or shift work clashed with normal tutorial time. The overall structure of the conference call was dependent upon the leadership or teaching style of the tutor. Some calls followed a pattern of lecture and discussion, while others were more informal. Individuals were asked to identify themselves when asking a question. Tutors invited named individuals to respond. Due to structured conversation, more individual participation was encouraged.

It was more difficult to describe via conference calls such subject matter as the sciences. Some felt telephone contact was restricting; some felt that the tutorial group was threatening at the center and felt more at ease with conference calls. Some who did not readily use telephones were unhappy with having to rely on the phone. More tutors felt that the main advantage was bringing study centers via phones to those who would otherwise not have been reached (Hammond, 1978).

Even when total systems cannot be embraced, incremental changes can be made which will permit greater interaction. If computer conferencing, for example, is unwieldy or impractical, perhaps videotapes can be used with telephone calls to course participants. In developing countries where resources are frequently stretched thin, classes may be quite large limiting faculty/student interaction. Any mechanism that personalizes the process benefits both faculty and student.

In order to satisfy the need for distance education, the Hungarian Ministry of Industry established the Bureau of Industrial Distance Education in 1984 which was reorganized to the Centre of Educational Technology, Ministry of Industry in 1987. Its principal objectives are:

1) to process and demonstrate techno-economic information with the help of educational technology to cover the entire industry as well as its specialized industrial branches;

2) to prepare information and educational materials to improve the standards of enterprise management, leadership, and organization;

3) to elaborate new educational forms (for instance, distance education) to assist the restructuring and modernization of the industrial structure; and

4) to supplement the products and technologies earmarked for export with educational packages, both as a reference and to provide information for operation and maintenance. (Forgacs, 1987, p. 5)

The Cranfield School of Management in England has provided graduate students with personal computers to enhance their communication ability despite part-time attendance. "While computers assigned for full time and part time MBA students is not new, the combination of providing PCs to par-time students in an MBA course for communication purpose is thought to be novel" (Kakabadse & Edwards, 1987, p. 3).

Fundamental questions addressed in the Cranfield experience were: a) who the students needed to contact and why; b) with whom greater contact is required and why; and c) the value of electronic mail to each individual.

This third point revolved around the communication lines of student to student, student to study group, student to study group leader, student to faculty, and student to administration.

> Does Cranfield have any choice to universally applying electronic mailing to long course programmes and, in the near future, to short course executive programmes? The answer is, no — there *is* no choice! From the customers' point of view, communication concerning academic and administrative matters is likely to be considerably enhanced through the use of electronic mailing. From the faculty point of view, despite initial feelings of greater intrusion, such a system will highlight which of the lecturing staff are both interested and committed to each programme, and pressurize others to either become more interested or drop the programme. (Kakabadse & Edwards, 1987, p. 9)

Computerized conferencing has been applied to executive development and continuing eduction. The Western Behavioral Science Institute based in La Jolla, California, uses computerized conferencing through the Electronic Information Exchange System (EIES) network to run multi-disciplinary development courses for high level industrial and government leaders. They are able to draw upon an international faculty as well as an international student body to participate jointly in a learning experience. A special benefit is that the entire range of transmissions remains intact for review and modification at will.

The implication of this for educational transmission is most provocative. One can begin to envision an international university of the future that transcends national boundaries. Computerized conferencing can be of benefit to education on a number of levels. It can be used for teacher training and development, for conventional course transmission, for management development as well as for continuing education. These courses can run as short or as long as is necessary which may have special value for short range projects of skill training.

In remote areas of the world where travel is time-consuming and expensive, as well as where there may be shortages of trained manpower, this would permit continued interaction for developmental purposes, and stretch the talent over broader terrains. The experience and insight of various locales can be helpful in providing examples of case studies to be generated for review and analysis by new neighbours and as yet unknown allies. This can well become the body of text for future sessions.

This is not a case of intellectual invasion but rather a new mode of collaboration. The representatives of developed countries have much to learn from the insights and experiences of their colleagues. Students of international affairs need to tap into the mainstream of contemporary experiences in developing countries.

With the increasing speed of research and development and the dissemination of knowledge, the person with a college degree no longer stays educated unless he/she continues the educational process. It is no longer the unusually motivated individual who for intellectual satisfaction takes occasional courses in topics of interest to him/herself. No more is it the exceptional professor who feels the need to remain current in his or her discipline.

In an earlier era the learned monk in the confines of his cell could follow purposeful independent study. So too independent study was feasible for the Heidelberg student. Today, however, the rapid rise of technology and worldwide demand for current knowledge mandates interaction between scholars.

FACULTY RECRUITMENT AND RETENTION

Let us assume a university which had limited resources for the faculty in terms of library materials, data base searches, graduate assistants and few colleagues in the designated field. There would be difficulty in recruitment for faculty from more developed countries. The institution might also examine the option of providing more development for existing faculty. In this latter circumstance they might well benefit from participation in an interaction system of education between countries.

What interactive technology permits is the development of faculty within their own locale. Individuals within isolated schools or within specialized disciplines hunger not only for access to new data, but also for interaction with those who have had similar training in their discipline. Those who have had similar academic preparation tend to have a common underpinning and world view that can be shared without too much explication. There is a common lingo, a readily grasped jargon which lies beyond interpretation. Preliminary concepts do not need to be made explicit but can be simply referred to. Even in circumstances where no specific information is transferred, there is a special pleasure in the sharing of views between individuals who come from the same discipline.

In considering mechanisms for faculty retention there are two approaches possible. The first is to provide specific skills in a relatively cost-effective manner such as discussed above. They can be rich in content and provide for interaction. The second approach is to use conferencing for administrative purposes such as deliberating on issues of organization and planning on line. In both instances there is a subliminal purpose served of establishing a social network. This provides a ready inducement for new faculty to join and existing faculty to remain longer.

One must also reexamine the view of longevity in organizations. In many instances, there needs to be a saving remnant of those who continue the history of the university and know its traditions. In the case of the developing country, there need to be rewards and incentives even for those whose connection to the university is of short duration. It may indeed be well advised to bring in individuals on very short contracts to serve as bridge builders or catalysts for continued interaction. In such cases, even after the visiting professor has left, relationships that have been forged can still continue to the benefit of both.

POLITICAL IMPLICATIONS

> Data is [sic] not merely an intellectual commodity but a political resource whose distribution through new information systems affects the interests of particular groups... The system designer seeks to ask who owns the data, who will share it, what will be the perceived impact on redistribution, on evaluation, influence and authority. (Keen, 1981, p. 23)

There are those who see education as a neutral good and those who see it as a powerful tool for the transmission of societal values. The truth lies between these views. What is here proposed is a schema that adds to the transmission of information, the overlay of a communications network. This can lead not only to the sharing of a knowledge base that is discipline grounded, but to a potentially rich level of interaction. If permitted to thrive, there can indeed be cross-fertilization of values and aspirations. Computers for educational purposes are indeed "powerful tools of a thousand faces" and those who see them only as drillmasters are as narrow as those who value only the computational aspects (Keen, 1981, p. 22).

More than a replacement for the telephone, mail or face to face meetings, computerized conferencing provides a medium for expanding human resources. There is constant and convenient access. Yet in the worst case communications technology may become a tool of the elite. Those who are already advantaged could become yet more isolated from the disadvantaged (Hiltz & Turoff, 1978).

It may be feasible to concentrate on building from the most innocuous connection to the most complex. To link individuals within the same region who share common concerns on curriculum design may be broached without too much hostility. Once one begins to consider crossing regions or venturing beyond a single discipline, the resultant "untidy" interaction may be seen as setting the groundwork for uncontrolled discussion. It is essential that the direction for interaction be established by the individual entities concerned (i.e., the region, the town) the discipline, etc. Again, where outsiders are invited to participate as consultants or advisers or facilitators, they need to make explicit the gains they anticipate receiving from such interaction. The reference to gains implies knowledge sought, field data, exchange of views, network building and so forth. Communication via interactive technology will become substantive and persuasive only if all participants put a value on such joint ventures.

If one examines a collaborative activity between two countries, a number of problems present themselves which could be daunting to the participants. There is a fourfold interaction of difficult planning schedules, tight financial controls, political pressure and cultural differences. Then, too, there are technical management problems presented by the new technology involved. Many are unable to fully use the wide range of sophisticated new techniques and organizational development now available. Many of the techniques were originally developed in situations where the social environment was much less hostile to new ideas in human resource development (Greig, 1987).

> Particularly in the countries with less economic potential, an unambiguous and positive correlation can be recognized between trends of R&D activity and the increase of competition. Such relation is specifically strong between the level of imported technologies and their inseparable "partner", i.e., the working capital and the improvement of competitiveness. On the one hand, more intensive progress in technical-economic cooperation can be recognized, while on the other hand, temporary or lasting polarization of people despite the general trend of cooperation. (Reininger, 1987, p. 4)

New development in international settings calls for societal flexibility and agility in the face of rapid change. These societies unable to develop or improve internal self-development would inevitably lag behind other nations.

Thus it is evermore incumbent on universities through intense and prolonged interaction to maintain the dialogue with dispersed colleagues. While one can speak of broad societal trends as being somewhat intransigent, there is much potential for the efficacy of individual linkages. And it is fitting that the university become the prime focus for cross-national development and growth.

While there are costs to this technology it should still be feasible even for countries with limited financial resources to participate.

> Observers, including tenured professors, are rarely indifferent to the fortunes of the organization where they find themselves. The strength of one's identification with organizational goals depends on a variety of factors such as position, career objectives, expectation of promotion, etc. Political identification and patriotic sentiment also affect intellectual outlook.... Changes in the distribution of power induced by computer use has been a favourite theme of pluralists at least since Downs predicted that urban information systems would result in power shifts from lower- to higher-ranking participants in urban politics and government. (Mowshowitz, 1981, p. 118)

The term, modernization, has been subjected to numerous definitions. In the political context, it embraces the social mobilization process which involves a change in the attitudes, values and expectations of people from those associated with the traditional world to those common to the modern world. In other words, the term denotes the consequence of literacy, education, increased communications, mass media exposure and urbanization (Huntington, 1968). We should not be misled, however, that it is in the interests of all nations to foster collaboration. Literacy and mass media may too often fuel the fire of discontent and dissatisfaction. Further, if there is wide governmental reaction and resistance to information sharing and knowledge transfer, the risks for participation become too great unless great care is given to sacrifice some degree of confidentiality. Broadly agreed upon categories can be transmitted without too much difficulty. Interpretation, however, becomes subject to considerably greater scrutiny and limitations.

In order to respond to the anxieties of certain countries or political regimes to the too rapid imposition of technology or perhaps improper connections with outside forces, one would have to stress first the equalization of comparable departments within a country. This should pose fewer problems since it is assumed that unanimity might more easily be achieved within a particular discipline within a designated region. One may, however, be overly optimistic. When cutting across various disciplines, there is likely to be more resistance from governmental bodies regulating access to telecommunications. And the ultimate configuration of linking individuals beyond parochial borders may be altogether too great a leap to expect at preliminary stages of a country's redevelopment. There is a difference between the goal of improving national learning or international knowledge. Perhaps one has to work sequentially here to develop the capabilities of the institution and region before further extension.

The examples from colonial education are instructive. One may assume that there are still local leaders, who while maintaining lip service to ideas of broad interactive learning, still recoil from the implications of an educated citizenry. The imprisonment of academics, and the relegation of scholars to years of agricultural service, do not bode well for broad peer interaction across boundaries. The technology exists that can foster and nurture scholarly interaction. It is not yet clear whether either developing or developed countries are prepared to embrace the concept today.

FUTURE CONCERNS

Although the values of interactive technology are legion, the computer cannot "contribute much to the learning of open-ended subjects like moral philosophy, religion, or historical interpretation, the fields of knowledge that cannot be reduced to formal rules and procedures" (Bok, 1985, p. 14).

Computer technology can serve several significant functions for education, research, and public service. Yet those who argue that certain topics do not lend themselves to technology have overlooked the larger issue of scholarly interaction. It is precisely these fields that are less quantitative and more abstract that can benefit more effectively from this heightened interplay. There has been a continuing anxiety that because technology permits exquisite precision, that it is antithetical to more abstract discussion. It is exactly such abstract fields that stand to grow more vitally because of a more prolonged exposure to the discourse of dispersed scholars.

> New technologies give us far more than added margin of flexibility in teaching and research. Taken together they represent one of the greatest opportunities for change in history of higher education.

> Similarly, the possibility that the new technologies will draw the international community of learning closer together depends in part on political and social forces... Universities can help remove such barriers by insisting on as free an interchange among scholars and institutions as they require within their own academic communities. (Barden & Golden, 1986, p. 15)

The role of the educator is likely to change in a fundamental way. He or she will be called upon to guide rather than command, to persuade rather than coerce, to participate more than compel, and to verify as much after the fact as before.

> These modes should revolve round concepts such as: capacity for extreme sensitivity to the slightest signs from outside or inside the enterprise; ability to anticipate in open systems (formation of project groups...); ability to integrate the speed of response as a strategic datum. (Ripoli, 1987, p. 21)

The role of the university is a pivotal one in providing the impetus for greater intellectual interaction. A community of international scholars can potentially disrupt the narrow confines of region and institution. While many agree in principle to such an intellectual expansion, it is equally necessary to recognize that a self-evident goal to some remains an unwelcome enigma to others.

The examples of business and industry can be instructive to universities as far as the technology as such. The experience of the university, however, must forge the link between the dimensions of technology as contrasted with the constraints placed on existing faculty. There is more of a social context within universities wherein the customary demands of scholarship do not always coincide with the needs of teaching to bring technology competence forward. The reward systems within universities must be flexible enough to consider the time invested by faculty members using the technology for pedagogical purposes rather than for research.

One recourse has been to develop journals and books which permit a scholarly discussion of such topics as teaching approaches, integration of equipment, and measurement of efficacy. Within developing countries there is a strong need to provide rewards to those "mavericks" who are willing to experiment with new technology. As noted earlier, it may be more advisable to concentrate on neutral activities such as administrative functions, rather than on those mechanisms that promote or provoke engagement with distant colleagues. It is easier to build incrementally onto an existing system which has proved its worth rather than to start anew with both new equipment and novel uses.

The possibility of computer-linked educational alliances holds significant promise for developed as well as developing countries. Yet there must always be an awareness of the social context in which such innovation takes place. This paper has constituted an initial assessment of the promise and peril of such exploration.

REFERENCES

Barden, R. A., & Golden, R. (1986, Summer). Networking and telecommunications on campus: A tutorial. *Educom Bulletin, 21(2),* 15-18.

Bok, D. (1985, Fall). Looking into education's high tech future. *Educom Bulletin, 20(3),* 1-17.

Combining education and work: Experiments in Asia, Oceania and Nepal. (1978). National Education Committee Report, Katmandu, Nepal.

International Development Research Centre (1981). *Computer-based conferencing systems for developing countries.* Report of Workshop held Ottawa, Canada, Author.

Ehrenburg, B. (1984). Teleconferencing: An emerging technology. *Educational Media International, 4,* 5-11.

Forgacs, L. (1987). *Applications of educational teaching methods for professional and management training programs and methods.* Conference of the European Economic Community and The ILO, Geneva, Switzerland.

Hammond, S. (1978, Summer). Teleeducation at the Open University. *Journal of Communication, 28(3),* 43-52.

Hiltz, S. R., & Turoff, M. (1978). *Network nation: Human communication via computers.* Reading, MA: Addison Wesley.

Huntington, S. P. (1968). *Political order in changing societies.* New Haven, CT and London: Yale University Press.

Johnson, J. W. (1981, October) Education and the new technology: A force of history. *Educational Technology,14(9),* 21-32.

Kakabadse, A., & Edwards, C. (1987). *Management education at a distance.* Paper presented at Symposium on Management Training Programs and Methods, Conference of the European Economic Community and The ILO, Geneva, Switzerland.

Keen, P. G. W. (1981, January). Information systems and organizational Change. *Communications of the ACM, 24,* 21-30.

Molnar, A. R. (1982, September). The search for new intelligent technology. *The Journal,* 5(8)6-11.

Mowshowitz, A. (1981, March). An approach to the study of social issues in computing. *Communications of the ACM, 24(3),* 111-123.

Muller, S. (1983-84). The Post-Gutenberg University: Colleges enter the information society. *Current Issues in Higher Education, 12(4),* 44-51.

Reininger, P. (1987). *Relation of new technology and new training methods.* Paper presented at Symposium on Management Training Programs and Methods. Conference of the European Economic Community and ILO, Geneva, Switzerland.

Ripoli, R. F. (1987). *Managers modes of action and trends in management Development.* Paper presented at Symposium on Management Training Programs and Methods, conference of the European Economic Community and ILO, Geneva, Switzerland.

Suppes, P. (1966). The uses of computers in education. *Scientific American, 15,* 206.

Van Horn, R. L. (1986, Winter). Brave new worlds: Computers revolutionize learning. *Educational Record,* 67(1) 52-59.
Winn, B. (1985). Minimizing problems in distance education. *Educational Media International, 1,* 111-120.

AUTHOR

Miriam K. Mills is a Professor of Organizational Science at the New Jersey Institute of Technology, Newark, NJ 07102. She is also a labor arbitrator and mediator.

Microware Review

Len Proctor

The Ethnographer

Reviewed by Margaret Thompson

This program will be of interest to anyone who has to analyze text, whether it be interview transcripts, documents, letters, student essays, or open-ended questions from questionnaires.

In 19851 was enrolled in a master's program, about to embark on a study concerning the attitudes of occupational therapists towards their students. This study entailed using qualitative research methods and the analysis of interview transcripts. As I talked to my committee members and began to read through the various texts relating to the analysis of text data I began to realise the magnitude of such a task.

Qualitative research studies such as mine involve the manipulation of segments of text. To do this the text being analyzed usually has to be duplicated several times in order for it to be appropriately catalogued. Should the researcher change his mind about his analysis, then the material has to be reorganised and perhaps recopied. As I was pondering which of the various methods I would choose to organise my data I was fortunate enough to hear of a computer program that another student was using called the Ethnograph. I investigated, I saw, and I was convinced. This was the system for me. It was a program that could turn the mountain of paperwork generated by qualitative research methods into manageable mole-hills.

I used Ethnograph (version 2) on an IBM XT compatible PC with two diskette drives and 640 K memory. Recently I received the updated version (version 3). This review is based on my experiences with version 2 but I will also describe the changes that have been incorporated into version 3.

Preparation of Files

The text to be analyzed is typed into the computer using any word processor that is capable of generating standard ASCII text files. Text must be prepared according to a certain format (i.e., only the left half of the page is used and there are certain rules concerning indentations).

At this point, the researcher can choose to insert information relating to the identity of the speaker as well as the contextual comments. This ensures that each time a segment of text is extracted it comes tagged with this information. These tags remain unchanged until new information concerning the speaker and context are added.

The speaker can be identified with a code word up to 10 characters long. I used this feature to identify my speakers sex, age, experience, country of education and location of practice. This meant that any extract of text generated by the computer was automatically tagged with demographic information. This process facilitated the formation of patterns based on the demographics of respondents and their attitudes.

Information relating to contextual comments allows the researcher to indicate the context from which a segment of text arises. This comment is restricted to 35 characters. I used this feature to identify the page of the verbatim transcript from which the segment was extracted and the question the respondent was answering. This phase of the program is completed by having the computer number each line of text. At this point no further changes to the text or the speaker identifiers and contextual comments can be made without starting from scratch and renumbering the text.

Coding

The print-out that is generated following the numbering procedure covers the left hand side of the page and consists of: the text; the speaker and contextual identifiers; and an assigned number for each line of text. The right side of the page is left empty for your handwritten comments relating to coding decisions. Once the file has been manually coded on the printout, it is entered into the computer.

Entering the codes is a slow process to begin with, somewhat akin to using the number keys on a typewriter when you are only used to the letter keys. However, once the rhythm of the process is developed this phase of the program can be completed fairly rapidly. This is especially true of the updated version which makes use of the arrow keys to move freely in any direction.

The beauty of the Ethnograph is that codes can be added, changed, or deleted as the study progresses with the pressing of just a few keys. Version 2 had some restrictions to this feature but version 3 has made recording as easy as the original coding process. The program permits the researcher to use up to 80 different codes. There is a restriction of no more than 12 codes per line of text of 7 clumps of texts nesting within each other. So far, I have not found these restrictions to cause any limitations.

Code Searches

Now comes the exciting part of the program when the results of the preparatory work becomes evident. Two options are available to the user: a single code search or a multiple code search. The single code search enables the files to be searched for up to 80 codes, one at a time. The program will search through the files for all incidences of the first code and then will return and start searching through for all instances of the second code. Up to 80 files can be searched at one time. Version 3 makes use of catalogues which will be explained later. This feature not only expands the number of files you can search but also facilitates the process of identifying the files that have to be searched.

The multiple code search mode permits search combinations of two codes. For examples, segments where *x* and *y* are present or where *x* is present but *y* is not can be extracted. It is possible to search for up to 15 of these combinations.

Results of searches can be sent to the screen, to disc, or to the printer and provides the user with the following information:

- the file the extract is taken from;
- the time and date the search was made (a feature of version 3);
- the page number;
- the code being retrieved;
- the speaker identifier;
- the contextual comment;
- symbols identifying the parameters of the segment relating to the code being searched; and
- a list of any other codes present in the extracted segment, together with an indicator of the extent of these segments.

With Version 3, codes can be searched in alphabetical order, or as they have been listed. Files which contain no segments relating to the search code are also identified. The combination of speaker identifier, contextual comments, and codes, when linked with the speed and manipulative ability of a computer and printer, produce an unbeatable combination for anyone whose work involves the analysis of text.

Version 3 Features

Some of the new features of version 3 have already been described but there are some additional ones that enable researchers to add another dimension to their studies. Such features include: listing code words/speaker identifiers; compiling catalogues of files; and producing face sheets for each file.

Listing code words/speaker identifiers. Ethnograph has the capability of reviewing each data file and generating a list of code works and/or speaker identifiers. These lists can be generated in alphabetical order, according to frequency or in both formats. This is a very useful feature because it allows a check to be made on code words that have been used to code a file, in case of spelling errors. It also provides the user with a very basic frequency count.

Compiling catalogues of files. In version 2 all the files that were to be searched had to be manually listed. With version 3 files can be grouped into catalogues and given names so that the insertion of one name containing *x* number of files will enable all the files within that catalogue to be searched. This feature will be a great time saver and also prevent the accidental omission of files.

Face sheets. Version 3 of the Ethnograph has the capability of generating a face sheet listing various variables for each file. Searches can be conducted for segments of text relating to a certain code in conjunction with specific parameters relating to the variables of a file. Up to 40 different variables can be identified. These variables can be either text or numeric (Note, the printout will only contain a listing of the first 6 variables used in the search). For example, a search of code x can be restricted to only those incidences occurring in interview data of males between the age of 16 and 17, who had failed two exams, were from urban schools with a population of more than a 1000, and who had been taught solely be female teachers!

Manual

This review would not be complete without commenting on the manual that comes with the Ethnograph program. If you can read a newspaper, you can understand this manual. It is the easiest, most user-friendly manual I have ever come across. Version 2 was a delightful surprise from your standard unintelligible computer manual but version 3 is a dream.

Each chapter starts with an explanation of the philosophy behind the particular phase of the program. This enables the user to understand the concepts and apply some meaning in terms of their own use of the program. Thus the manual goes beyond the giving of a "recipe" and allows the reader to create their own recipes using the ingredients they have at their fingertips, to meet their own needs.

Conclusion

Some readers will note that this review has been one of praise with no criticisms. I used the Ethnograph (version 2) to analyze approximately 600 pages of single spaced interview transcripts and a simple questionnaire. I found it was invaluable for my needs. My quick review of version 3 makes me impatient to use it on another project. However I do have one criticism and that relates to the support that is provided to owners of the Ethnograph. Written enquiries receive no response, an experience that I understand is shared by other owners of the Ethnograph. However one colleague of mine found that support was provided when contact was made by telephone. Whether the proliferation of Ethnograph as Version 3 hits the marketplace will change this problem of satisfactory written communication remains to be seen.

I recommend the program highly. Just remember that if you want help, be prepared to phone not write!

REVIEWER

Margaret Thompson is a recent graduate of the Department of Communications, Continuing and Vocational Education. She is currently working as a Occupational Therapist in the Department of Occupational Therapy at the University Hospital in Saskatoon.

Overhead Express

Reviewed by Richard A. Schwier

Business and Professional Software, Inc., 143 Binney Street, Cambridge, Massachusetts 02142, (617) 491-3377.

Hardware Requirements: PC-DOS/MS-DOS, 192kb RAM, 2 disk drives, printer.

Textual overhead transparencies are arguably the most significant source of torture inflicted on students at all levels. Who among us has never been subjected to a demented math teacher who delighted in the interplay of blunt transparency pens and equally obscure formulae?

Riding to the rescue is a simple program from Business & Professional Software, Inc. called Overhead Express. Overhead Express is a program for creating textual overhead transparency masters — nothing else. Sure, you can use the masters as garage sale signs, but in essence, Overhead Express is dedicated software. This dedication is its greatest charm and its most serious limitation, but within this precise focus, the program ranges from extremely simple to quite sophisticated.

The Package

Overhead Express is menu driven from the front-end, and from this point you can elect to create presentations in one of two editors, review existing work, print the completed transparency masters and alter the system configuration. I'll introduce you briefly to each of the major components of the package.

The Express Editor contains twelve fill-in-the-blank templates with many of the more common types of transparencies represented. It is extremely easy to use; if you have some experience with other tools, you will be able to figure this one out without even looking at the documentation. I have found that this editor meets most of my production needs.

The Custom Editor allows you more flexibility to make your own transparency masters, templates and screen presentations. Although you will probably use it less frequently, it is worth the trouble. The custom editor is somewhat more difficult to learn, but no problem if you have ever used a word processor which required "dot commands."

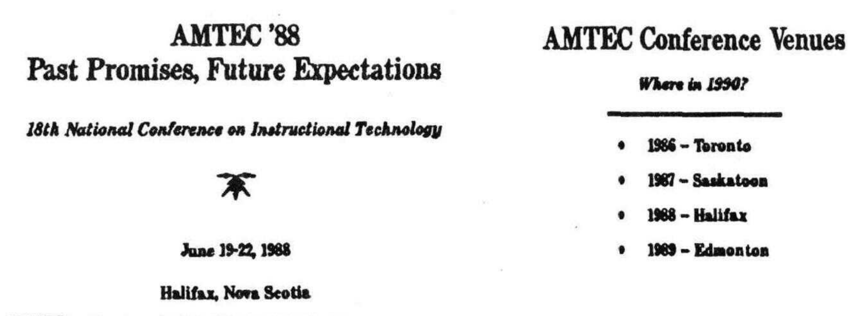
Review on Screen permits you to check your work on screen before you bother printing. Another option checks files for errors.

The Documentation in Overhead Express is well designed and includes tutorials, many useful examples and fairly comprehensive system descriptions and options.

The Express Editor

This is the quickest way to produce transparencies. You are offered twelve pre-designed templates which can be visually scanned by pressing Fl. These twelve represent a handy assortment of common productions needs: A list of centred or left justified points, title page, outline, grid, budget, quotation, two- and three-level cross breaks, prose, titles with a window for illustrations and a two column comparison *(see Figure 1 for examples).*

Figure 1. *Examples of Transparencies Using the Express Editor.*



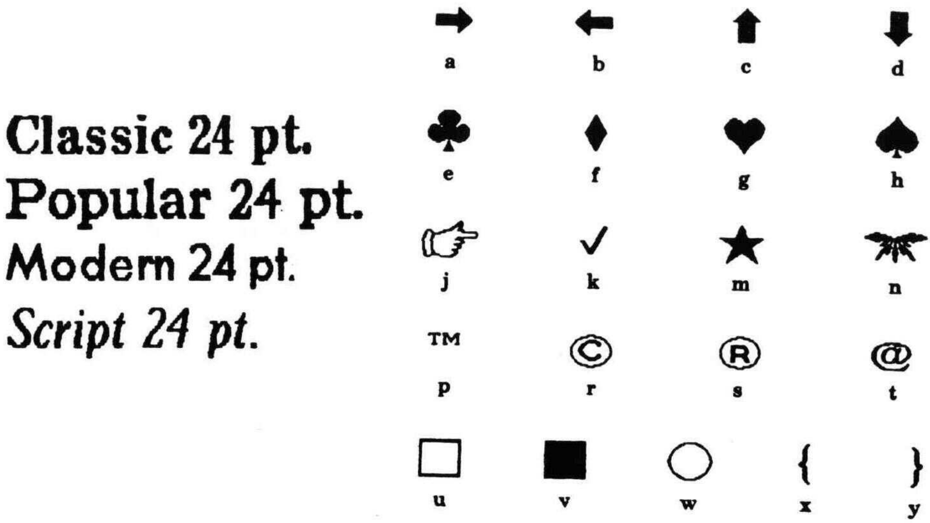
I have found that I seldom wander from these twelve templates because they are so easy to use, and the results are so pleasing—there's the rub. I often catch myself trying to conform my content to the formats offered rather than going to the trouble to custom design a format more naturally suited to my needs. Now this is certainly self-criticism, not a criticism of the software, but I suspect there are a number of you who would also yield to the sirens's song. Let this be fair warning that Overhead Express will lure you toward the rocks.

The Custom Editor

The custom editor, although more cumbersome to use, gives you access to the full range of layout, fonts and highlighting offered by this package. In addition to producing overhead transparency masters, you may also use the custom editor to develop screen presentations for displays and the like. There are a variety of fonts and a number of graphic symbols *(see Figure 2 for examples).* These can be used in different sizes and emphasized using shadows and highlighting features to produce several different effects.

The custom editor is not difficult to use if you have any experience with embedded dot commands and escape commands in early word processors. In this editor, dot commands (e.g., font) are used to define parameters that remain in effect for up to an entire page. Backslash commands (e.g., \font) remain in effect for only a single line, or until turned off within a line. The resulting series of commands do not resemble the final product, and you need to review the completed product on screen to determine whether you have what you want *(see Figure 3 on page 204).*

Figure *1. Samples of Fonts and Symbols Available.*



The custom editor can also be used to string together several frames, each shown for a designated time period using a .wait <# seconds> command. The result is a screen show, the type you might see at a trade show display where several screens of information are shown in sequence. This isn't somethingyou will use every day, but it is nice to have around for special occasions.

Checking and Producing Presentations

Several options on the main menu allow you to check your presentations and finally produce them on either the screen or printer. Under Check Presentation you can either Review on Screen a reduced version ofyour final product as it will appear when you actually print it, or select Verify Presentation and check the presentation file (all of the commands and text) for errors either automatically or manually. I usually restrict my selection to Review on Screen, as my main interest is in the 'look' of the transparency master.

Finally you may produce your file (which may contain several transparencies or screens) on either a printer or the screen. Caution! Producing on screen is specifically for those rarely created screen shows — not transparencies. The format of a transparency is different than the format for a monitor screen. There is no reduction of the image to make your transparency fit on your monitor. As a result, only a portion of the image is reproduced on the screen. To review your transparencies on screen before printing them, you must select Review on Screen under Check Presentation. This is a minor, yet disconcerting, bit of confusion in the main menu of the program.

Another limitation of the program is in its system configuration. Among

Figure 3. *Commands and Product from the Custom Editor.*

```
:.page
:.elastic
:See you in
:.elastic
:.font S60
:.box
:Edmonton
:.box end
:.elastic
:.font C40
:for
:.elastic
:AMTEC '89
:.elastic
```

See you in

Edmonton

for

AMTEC '89

other things, you will need to specify the printer being used, paper dimensions and graphics adaptor. The list of printers accommodated by Overhead Express is very limited, and includes only the mainstream of printers. Still, given that most "fringe" printers use the same protocol as one of the mainstream printers, you will probably find that one of the configurations works. I managed to connect an Apple Imagewriter to an IBM XT for this program successfully after playing for about two hours.

Documentation

The documentation for this program was unnecessary for the rudimentary use of the program—high praise! For more sophisticated applications, I found the documentation well designed, clearly and economically written and comprehensive. Users who are comfortable with the format of the IBM DOS manuals (a breed apart) will enjoy the Reference section, which mimics that format.

Recommendation

For a simple, inexpensive, dedicated piece of software, Overhead Express receives my heartiest applause. It is easy to use and effective. I use it often and my students are grateful.

My main reservation is that because it is primarily textual, graphic images may be relegated to the back bench . . . and yes, to those of you firmly entrenched in the Apple orchard, the Mac can do many of the same things using other software ... and incorporate graphics easily.

REVIEWER

Richard A. Schwier is a Professor in the Department of Communications, Continuing and Vocational Education, University of Saskatchewan, Saskatoon, SK S7N OWO.

Index to Volume 17, 1988

Articles *(by title)*

Articles *(by author)*

Columns *(by title)*

Columns *(by author or editor)*

Book Reviews *(by title)*

Book Reviewers

Notice of Change in *CJEC* Policy

At its June meeting, the Board of Directors of the Association for Media and Technology in Education in Canada (AMTEC) voted to reduce the number of issues per year of *CJEC* from four to three, beginning with the current year. Therefore, Volume 17, Number 3 is the last issue of *CJEC* for 1988. The rising cost of production and distribution is the primary reason for this change.

Beginning in 1989, *CJEC* will be mailed on March 1, July 1, and November 1.

Call for Applications

Editor of the Canadian *Journal qf Educational Communication*

The AMTEC Board Invites applications for the position of Editor of the *Canadian Journal qf Educational Communication* beginning with Volume 19 (1990) and ending with Volume 21 (1992). Previous experience in academic publishing is preferable, as is affiliation with an institution that values and supports academic publication and the goals of *CJEC.* Access to student assistants would be an asset.

The Editor of CJEC is responsible for all aspects of publication including receiving, processing and reviewing manuscripts, maintaining a staff of expert reviewers, advertising the journal and overseeing the quality of the final product. Other tasks related to the production process (typesetting, printing and mailing) are negotiable with the Board. Interested persons should send a curriculum vitae to:

Mr. Wayne Blalr
Associate Director of Curriculum
Alberta Department of Education
11160 Jasper Avenue
Edmonton, AB T5K OL2
(403) 422-4872

Information for Authors

CJEC welcomes papers on all aspects of educational communication and technology. Topics include, but are not limited to: media and computer applications in education, learning resource centers, communication and instructional theory, instructional design, simulation, gaming and other aspects of the use of technology in the learning process. These may take the form of reviews of literature, descriptions of approaches or procedures, descriptions of new applications, theoretical discussions and reports of research.

Manuscript Categories

Manuscripts may fall into one of two classes: *General,* dealing with a topic or issue at a general level (although reference to specific instances or examples may be included), and *Profiles,* dealing with or describing only a specific instance of an approach, technique, program, project, etc. A Profile may be thought of as a descriptive case study.

Most manuscripts dealing with a topic in general should include reference to supportive literature, while manuscripts submitted to the Profile category may or may not. The Editor reserves the right to change the designation of a manuscript or to make a designation, if none has been made previously by the author. Authors interested in determining the suitability of materials should consult past issues of *CJEC* or contact the Editor.

All manuscripts received by the Editor (either general or profile) will be judged for suitability, contribution, accuracy, etc. by a panel of anonymous reviewers designated at the time of submission. Normally, the review process requires about eight weeks. There are no deadlines for the submission of manuscripts.

Manuscript Preparation

Manuscripts should be typed on 8 1/2 x 11-inch ordinary white paper. All materials must be double-spaced, including quotations and references. Include a title page on which appears the title of the manuscript, the full name of the author(s) along with position and institutional affiliation, mailing address and telephone number of the contact author. An abstract of 75-150 words should be placed on a separate sheet following the title page. While the title should appear at the top of the first manuscript page, no reference to the author(s) should appear there or any other place in the manuscript. Elements of style, including headings, tables, figures and references should be prepared according to the *Publication Manual of the American Psychological Association, 3rd Edition.* 1983. Figures musf be camera-ready.

Submission of Manuscripts

Send four copies of the manuscript to the Editor along with a letter stating that the manuscript is original material that has not been published and is not currently being considered for publication elsewhere. If the manuscript contains copyright materials, the author should note this in the cover letter and indicate when letters of permission will be forwarded to the Editor. Manuscripts and editorial correspondence should besentto: Robert M. Bernard, *Canadian Journal of Educational Communication,* Education Department, Concordia University, 1455 de Maisonneuve Blvd. W., Montreal, PQ, H3G 1M8,